United States Department of Agriculture

Natural Resources Conservation Service

In cooperation with North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee

Soil Survey of Burke County, North Dakota

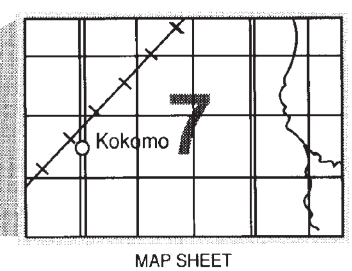
The soil properties and interpretations included in this survey were current as of 2003. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

How to Use This Soil Survey

General Soil Map (STATSGO)

The general soil map, at the back of the section entitled “General Soil Map Units (STATSGO), shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, and then refer to the description of the area.

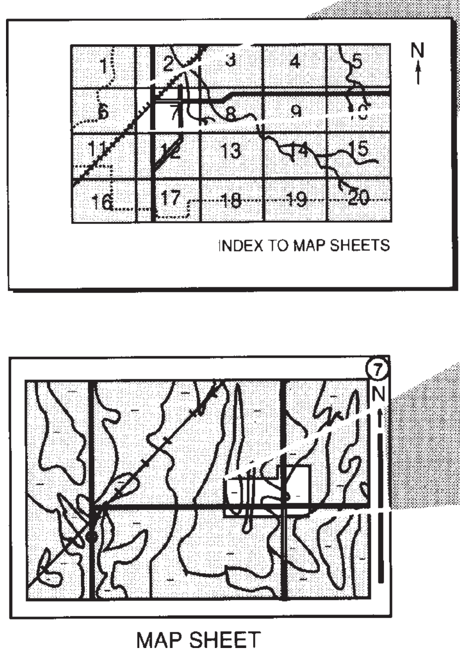


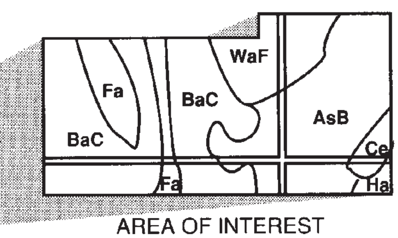
Detailed Soil Maps

The detailed soil maps are found in the packet accompanying the book. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map unit symbol that is in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.





The **Contents** shows which table has data on a specific land use for each detailed soil map unit. Also see the **Contents** for sections of this publication that may address your specific needs.

For additional information concerning the use of soil surveys refer to North Dakota State University Extension Service Bulletin 60, “Soil Survey: The Foundation for Productive Natural Resource Management,” (Seelig, 1993) and to the USDA-NRCS publication “From the Surface Down: An Introduction to Soil Surveys for Agronomic Use,” (Broderson, 1991).

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies, including the Agricultural Experiment Station, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1991. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1987 to 1999. This survey was made cooperatively by the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, and North Dakota State Soil Conservation Committee. It is part of the technical assistance furnished to the Burke County Soil Conservation District. Financial assistance was provided by the Burke County Board of Commissioners and the Burke County Soil Conservation District.

Cover: View of rolling hills and depressions typical of the Missouri Coteau in southern Burke County.

Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is http://www.nrcs.usda.gov (click on" Technical Resources").

Contents

Issued 2003

Foreword

This soil survey contains information that can be used in land-planning programs in Divide County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the STATSGO general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Thomas E. Jewett
State Conservationist
Natural Resources Conservation Service

Where to Get Updated Information

The soil properties and interpretations included in this survey were current as of 2002. The most current information is available through the Natural Resources Conservation Service Soil Data Mart Website at http://soildatamart.nrcs.usda.gov/ and/or the Natural Resources Conservation Service Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/app.

Additional information is available from the Natural Resources Conservation Service Field Office Technical Guide in Mandan, North Dakota, or online at www.nrcs.usda.gov/technical/efotg. The data in the Field Office Technical Guide are updated periodically.

Additional information about soils and about NRCS is available through the North Dakota NRCS Web page at www.nd.nrcs.usda.gov.

For further information please contact:

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Bowbells Field Office
5 Roosevelt Avenue
Box 336
Bowbells, ND 58721-0336
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Soil Survey of
Burke County, North Dakota

Manuscript by Richard Rolling and Thomas Dhuyvetter, Natural Resources Conservation Service.

Fieldwork by Thomas Dhuyvetter, Robert Casteel, Gordon Green, Richard Rolling, Jerome Schaar, Michael G. Ulmer, and Robert Murphy, Natural Resources Conservation Service, and Wilhelm Soil Consulting, Inc., professional soil classifier.

United States Department of Agriculture, Natural Resources Conservation Service,
in cooperation with
North Dakota Agricultural Experiment Station, North Dakota Cooperative Extension Service, North Dakota State Soil Conservation Committee, North Dakota State Department of Transportation, Burke County Board of Commissioners, and the Burke County Soil Conservation District.

Map finishing by the North Dakota State Soil Conservation Committee.

General Nature of the Survey Area

BURKE COUNTY is in the northwestern part of North Dakota (fig. 1). The county has a total area of 722,700 acres, or 1,121 square miles. It has 7,400 acres of water in bodies of more than 40 acres in size. The county seat is Bowbells.

The first recorded settlement in the area was at Portal in 1883. Additional information concerning the history and development of Burke County can be obtained from the Burke County Historical Society.

The county is in the Northern Dark Brown Glaciated Plains (Major Land Resource Area 53A), Central Dark Brown Glaciated Plains (Major Land Resource Area 53B), and the Northern Black Glaciated Plains (Major Land Resource Area 55A) of the Northern Great Plains Spring Wheat Region (USDA-SCS, 1981)

The southern part of the county is in the Missouri Coteau District of the Missouri Plateau Section of the Great Plains Province and the northern part is in the Drift Plains District of the Western Young Drift Section of the Central Lowland Province (Freers, 1973).

Elevation in the county ranges from 1,800 feet above sea level at the Upper Des Lacs Lake to over 2,500 feet in the Coteau. The northern portion of the county has a poorly developed drainage system with generally shallow valleys and sloughs draining into the Souris-Red River Basin. This water eventually flows into the Hudson Bay. The central and southeastern portions of the county have a nonintegrated drainage system where surface runoff is toward numerous small local basins and sloughs. Drainage in the southwestern portion of the county is generally well developed and is toward the Missouri River.

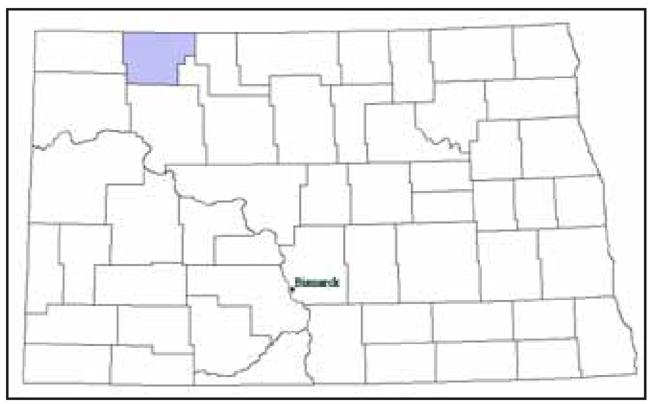

Figure 1. Location of Burke County in North Dakota.

Farming and ranching are the main economic enterprises. The principal crops are spring wheat, durum wheat, barley, oats, sunflower, and hay (Beard and Waldhous, 1998). The Burke County Soil Conservation District was organized in 1946.

The soils in the county are mostly very deep and suited to cropland, except the hilly and steep areas which are best suited to pasture and hayland. The soil parent material is mostly of glacial origin, with significant areas of till and glaciofluvial deposits. In some areas, the soil parent material is a combination of eolian soil material and till. Several of the soils contain sodium salts or other salts that adversely affect crops. Many of the soils are susceptible to soil blowing or water erosion. A significant acreage of wet and ponded soils now produce or previously produced wetland wildlife habitat.

The first soil survey of Burke County was published in the 1908 Soil Survey of Western North Dakota (Lapham, 1910). A general soil map of the county was published in 1968 (Patterson, et al. 1968). The present survey provides additional information and larger scale maps and shows the soils in more detail.

About 56 percent of the area is cropland, and 44 percent is rangeland, hayland, or other land (USDA-SCS, 1992). Additional information related to agriculture in Burke County can be found in Census of Agriculture (USDA-NASS, 1999). Additional information concerning the ground water resources in Burke County has been compiled by Freers (1973).

Climate

The climate of Burke County is semiarid to subhumid and continental. The area is usually quite warm in summer with frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the area. Most precipitation falls in late spring and early summer.

Table 1, “Temperature and Precipitation,” gives data on temperature and precipitation for the survey area as recorded at Bowbells, North Dakota, in the period 1961 to 1990. Table 2, “Freeze Dates in Spring and Fall,” shows probable dates of the first freeze in fall and the last freeze in spring. Table 3, “Growing Season,” provides data on length of the growing season.

In January, the average temperature is 5 degrees F, and the average daily minimum temperature is -5 degrees F. In July, the average temperature is 68 degrees F., and the average daily maximum temperature is 82 degrees F.

Growing degree days are shown in Table 1. They are equivalent to “heat units.” During the month, growing degree days accumulate by the amount the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The average annual total precipitation in the county is about 17 inches. Of this, about 14 inches, or 80 percent, usually falls in April through September. The growing season for commonly grown crops falls within this period. Rainfall amounts occurring in 2 years out of 10 are also shown on Table 1. This information is useful in designing a management system for wet and dry years.

Average annual snowfall is 30 inches. The average relative humidity at midafternoon in July is about 45 percent. The sun shines 75 percent of the possible time in July and 45 percent of the time in November. The sun shines an average of 62 percent of the possible time annually. The prevailing wind is from the southwest. The average annual windspeed is 10 miles per hour (Jensen, 1972).

How This Survey Was Made

This survey was made to provide information about the soils and miscellaneous areas in the survey area. The information includes a description of the soils and miscellaneous areas and a discussion of the suitability, limitations, and management of the soils and miscellaneous areas for specified uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down to the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by biological activity.

Soils and miscellaneous areas in the survey area are in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind or segment of the landscape. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landscape, soil scientists develop a concept, or model, of how the soils were formed. Thus, during mapping, this model enables soil scientists to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Individual soils on the landscape commonly merge

into one another as their characteristics gradually change. To construct an accurate map, however, soil scientists must determine boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationships, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded characteristics of the soil profiles they studied. They noted color, texture, size, and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils (fig. 2). After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison and to classify soils systematically. Soil Taxonomy (Soil Survey Staff, 1999), the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After soil scientists classified and named the soils in the survey area, they compared individual soils with similar soils in the same taxonomic class in other areas so they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area are collected for laboratory analyses and for engineering tests. Soil scientists interpret data from these analyses and tests as well as field-observed characteristics and soil properties to determine expected behavior of soils under different uses. Interpretations for the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations may be developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict a high water table will always be at a specific level in the soil on a specific date.

Figure 2. Profile of Hamerly loam. The dark colored surface layer is underlain by a light colored layer that has an accumulation of lime.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

The descriptions, names, and delineations of the soils in this survey area do not fully agree with those of the soils in adjacent survey areas. Differences are the result of a better knowledge of soils, modifications in series concepts, or variations in the intensity of mapping or in the extent of the soils in the survey areas.

Survey Procedures

The general procedures used to make this survey are described in the National Soil Survey Handbook (Soil Survey Staff, 1996) and the Soil Survey Manual (Soil Survey Staff, 1993. The Major Soils of North Dakota (Omodt, et al., 1968), Soil Taxonomy (Soil Survey Staff, 1999), and Land Resource Regions and Major Land Resource Areas of the United States (USDA-SCS, 1981), were among the references used. The procedures used in determining the nature and characteristics of the soils are described under the heading “How This Survey Was Made.”

All soil mapping was done on field sheets developed from high-altitude black and white aerial photographs from the National High Altitude Photography (NHAP) Program. The scale of the field sheets was 1:24,000 or 2.64 inches to the mile. Detail of these field sheets was checked with older aerial photography, color infrared photography, and in some instances, topographic maps.

Soil delineations were drawn on field sheets by traversing the land on foot, by pickup with mounted hydraulic soil probe, or by all-terrain vehicle. Traverses were planned to cross all major landforms and were at intervals close enough to locate contrasting soil areas of about 3 to 5 acres. Soils were examined to a depth of 3 to 5 feet, depending on the kind of soil. Soil properties, including color, texture, structure, horizonation, and presence of salts and stones were examined.

All map units were characterized for soil variability by transecting representative areas. A transect is a series of detailed soil examinations done in a map unit delineation to determine the range of composition of various kinds of soil and soil properties. One transect was required for each 1,000 acres of the unit mapped.

Data collected from the transects were used to determine map unit names and establish the range of composition of soil in each map unit. A statistical method explained by Brubaker and Hallmark (1991) was used for the analyses. This method predicts, at a 90 percent confidence level, the average composition in the county for each named map unit component and similar soil will be between the range given in the map unit description.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Soil pedons were sampled for soil characterization or engineering test data. The soil analyses were made by the Natural Resources Conservation Service’s Soil Survey Laboratory at Lincoln, Nebraska and the North Dakota State Department of Transportation’s Materials and Research Laboratory.

Table 1.--Temperature and Precipitation

(Recorded in the period 1961-90 at Bowbells, North Dakota.)

Month	Temperature						Precipitation			
				2 years in 10 will have		avg no. of		2 yrs in 10 will have		average number of
	avg daily max	avg daily min	avg	max temp. >than	min temp. <than	growing degree days*	avg (in.)	less than (in.)	more than (in.)	days with 0.10 inch or more
January	15.5	-5.0	5.2	45	-35	0	0.52	0.15	0.89	2
February	21.5	0.7	11.1	49	-30	0	0.50	0.12	0.79	1
March	34.1	13.3	23.7	67	-20	13	0.58	0.17	0.94	1
April	52.0	27.5	39.7	83	2	119	1.55	0.42	2.45	3
May	66.2	39.0	52.6	92	20	401	2.32	1.11	3.50	5
June	76.1	48.7	62.4	95	33	656	2.97	1.45	4.28	6
July	82.0	53.4	67.7	100	40	850	2.68	1.28	3.89	5
August	80.6	50.4	65.5	100	33	782	2.22	0.92	3.31	4
September	67.7	40.4	54.0	95	23	415	2.01	0.83	3.00	3
October	55.8	29.7	42.8	83	8	166	1.02	0.20	1.77	2
November	35.5	15.2	25.4	67	-15	14	0.36	0.13	0.60	1
December	20.6	0.6	10.6	50	-32	0	0.37	0.12	0.60	1
Yearly :										
Average	50.6	26.2	38.4	—	—	—	—	—	—	—
Extreme	104	-40	—	102	-36	—	—	—	—	—
Total	—	—	—	—	—	3,416	17.08	13.28	20.65	34

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures,dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (Threshold: 40.0 deg. F)

Table 2.--Freeze Dates in Spring and Fall

(Recorded in the period 1961-90 at Bowbells, North Dakota.)

Probability	Temperature		
	24F or lower	28F or lower	32F or lower
Last freezing temperature in spring :			
1 year in 10 later than--	May 13	May 27	June 4
2 year in 10 later than--	May 9	May 21	May 29
5 year in 10 later than--	April 30	May 11	May 19
First freezing temperature in fall :			
1 yr in 10 earlier than--	September 22	September 2	August 28
2 yr in 10 earlier than--	September 27	September 10	September 2
5 yr in 10 earlier than--	October 8	September 24	September 13

Table 3.--Growing Season

(Recorded in the period 1961-90 at Bowbells, North Dakota.)

Probability	Daily Minimum Temperature		
	# days > 24F	# days > 28F	# days > 32F
9 years in 10	127	103	92
8 years in 10	133	111	100
5 years in 10	145	128	115
2 years in 10	157	144	130
1 year in 10	163	153	137

General Soil Map Units (STATSGO)

The general soil map which precedes the detailed soil maps was derived from STATSGO (State Soil Geographic Data Base). STATSGO (USDA-NRCS, 1994) is a small scale digital general soil map of North Dakota and an accompanying data base. It shows broad areas that have a distinctive pattern of soils, relief, and drainage. These similar areas are delineated into general soil map units or soil associations. Each soil association is a unique natural landscape. Typically, they consist of one or more major soils or components and some minor soils or components. The soils making up an association can occur in another association but in a different pattern. The STATSGO map can be used to compare the suitability of large areas for general land uses. Areas of soils suitable for a practice or use can be identified on the map. Likewise, areas that are not suitable can be identified. Broad interpretive groups can be developed using STATSGO data. STATSGO maps are designed to be used primarily for multi-county and state resource evaluation and planning. Interpretive tables and maps can be prepared for North Dakota, or for smaller areas within the state. STATSGO maps can be used as part of a geographic information system (GIS).

The STATSGO map was compiled by generalizing more detailed soil survey maps. Information on the geology, topography, vegetation, and climate was also considered in the development of this map. The data base contains information on each association's acreage and composition. It also contains soil properties and interpretive data.

Maps were compiled at a scale of 1:250,000 (1 inch = 4 miles). The smallest delineations are about 1,500 acres in size. STATSGO maps are prepared nationwide at the same scale and join across county and state boundaries. The maps meet national standards for mapping conventions and scale. Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Descriptions for STATSGO associations in Burke County begin on page 18. The composition of the named components in the association description includes soils that are similar in properties and behavioral patterns. Not all minor components are listed.

The North Dakota STATSGO map and data base are maintained by the USDA-NRCS Soils Section in Bismarck, North Dakota. For more information on the use of STATSGO, or on the availability of interpretive tables and maps, contact the state NRCS office.

14—Swenoda-Barnes-Hamerly Association, nearly level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Swenoda	FSL	1-6	W	35-40
Barnes	L	1-6	W	20-25
Hamerly	L	1-3	SP	10-15
MINOR COMPONENTS				
Tiffany	FSL	0-1	P	5-10
Tonka	SIL	0-1	VP	5-10
Letcher	LFS	1-3	MW	5-10
Maddock	LFS	1-6	SE	5-10

* L, loam;FSL, fine sandy loam;LFS, loamy fine sand;SIL, silt loam
** VP, very poor; SP, somewhat poor;P, poor; MW, moderately well;W, well;SE, somewhat excessive

Description

These soil areas are level to undulating with numerous gentle rises separated by a few shallow swales and depressions. The dominant soils formed in medium textured glacial till or moderately coarse textured outwash. Most areas are used for cropland.

The Swenoda soils are on lower side slopes and flats. They have outwash materials over glacial till. Barnes and Maddock soils are on gentle convex side slopes and broad, convex crests of rises. Maddock soils are sandy. Hamerly soils are on gentle convex positions adjacent to depressions and on flats. Tiffany soils are in swales. Tonka soils occur in depressions. Letcher soils are sodium affected and are intermingled with the Swenoda soils. The Hamerly soils have a prominent “high lime” layer which is within plow depth in many area. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind erosion is a concern on most of these soils. Portions of these areas have periods of wetness and ponding in the spring and after heavy rains. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

53—Barnes-Cresbard Association, level to undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Barnes	L	1-6	W	40-45
Cresbard	L	0-3	MW	30-35
MINOR COMPONENTS				
Cavour	L	0-3	MW	5-10
Tonka	SIL	0-1	P	5-10
Hamerly	L	0-3	SWP	5-10
Buse	L	6-9	W	1-5
Vallers, saline	L	0-1	P	1-5

* L, loam; SIL, silt loam
** SP, somewhat poor; P, poor; MW, moderately well; W, well

Description

These soil areas are level to undulating with many low, irregularly shaped rises separated by shallow swales and a few poorly drained depressions. The soils formed in medium textured glacial till. Most areas are used for cropland

The Barnes soils are on gentle convex side slopes and broad, convex crests of rises. The Cresbard and Cavour soils are intermingled with or occur below the Barnes soils (fig. 3). They are sodium affected. Tonka soils occur in depressions. Hamerly and Vallers soils occur on gentle convex positions adjacent to depressions and on flats. Buse soils are on sloping convex rises. The Buse, Hamerly, and Vallers soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Few agricultural limitations exist on these areas. The sodium-affected soils may have limited root and water penetration. Wind erosion is a concern on the “high lime” soils. Portions of these areas have periods of wetness and ponding in spring and after heavy rainfall. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

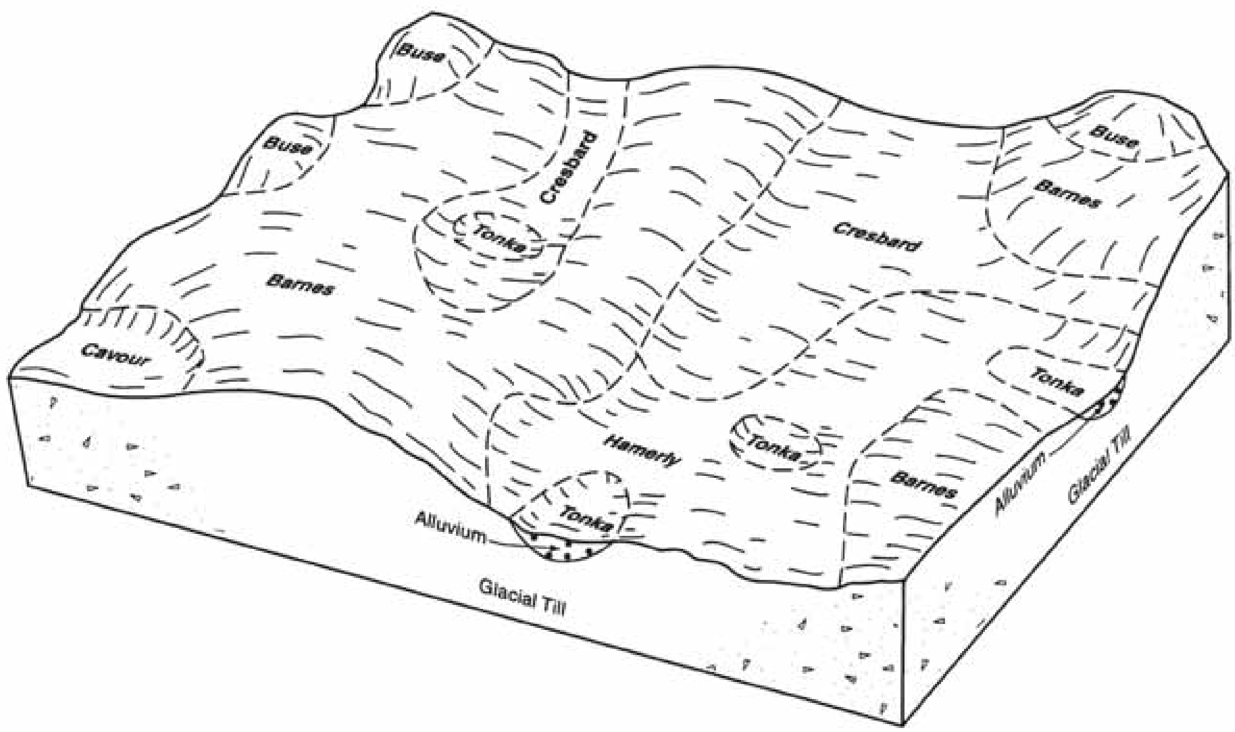

Figure 3. Typical pattern of soils and parent material in the Barnes-Cresbard association.

75—Williams-Zahl-Bowbells Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Williams	L	0-9	W	55-60
Zahl	L	3-9	W	15-20
Bowbells	L	0-6	W	10-15
MINOR COMPONENTS				
Bowdle	L	0-6	W	1-5
Parnell	SICL	0-1	VP	1-5
Tonka	SIL	0-1	P	1-5
Noonan	L	0-6	W	1-5

* L, loam; SIL, silt loam;SICL, silty clay loam
** VP, very poor; P, poor; W, well

Description

These soil areas consist of level to gently rolling topography with irregularly-shaped knolls separated by concave swales, drainageways, and broad flats. The dominant soils formed in medium to moderately-fine textured glacial till. Most areas of this association are used for cultivated crops.

Williams soils occur on gentle, convex side slopes and broad, convex crests of knolls and ridges. Zahl soils occur on steeper, prominent knolls and ridges. Bowbells soils occur on concave side slopes, footslopes, and flats. Bowdle soils occur on flats and have a gravelly substratum that restricts root growth. Parnell and Tonka soils occur in depressions and potholes. Noonan soils occur on concave side slopes and have a sodic subsoil that restricts root growth. Zahl soils have a prominent "high lime" layer which occurs within plow depth. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind and water erosion are concerns on some of the steeper areas. The poorly and very poorly drained soils generally have periods of wetness and ponding in the spring and after heavy rains. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

87— Zahl-Williams-Parnell Association, level to steep

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Zahl	L	6-35	W	40-45
Williams	L	3-25	W	35-40
Parnell	SICL	0-1	VP	15-20
MINOR COMPONENTS				
Southam	SICL	0-1	VP	5-10
Wabek	L	6-25	E	1-5

* L, loam; SICL, silty clay loam
** VP, very poor;W, well;E, excessive

Description

These soil areas consist of level to steep topography with knolls, ridges, and very poorly drained soils in depressions and potholes. The dominant soils formed in medium to fine textured glacial till and local alluvium. Most areas of this association are used for rangeland or hayland with some undulating areas between depressions used for cropland.

Zahl soils occur on steep, convex slopes on knolls and ridges. Williams soils occur on convex and plane side slopes and broad, convex crests of knolls and ridges. Parnell and Southam soils occur in depressions and potholes. Wabek soils occur on knolls and some ridges. They have a gravelly substratum that restricts root growth.

Major Limitations for Agricultural Use

Water erosion is a concern on steep areas. Agricultural production can be difficult because of the high density of depressions and steep slopes adjacent to potholes. The very poorly drained soils generally have wetness and ponding in the spring and after heavy rains. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

112 —Wabek-Appam-Lehr Association, level to hilly

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Wabek	SL	3-25	W	50-55
Appam	SL	0-15	W	30-35
Lehr	L	1-6	W	15-20
MINOR COMPONENTS				
Williams	L	3-25	W	1-5
Parnell	SIL	0-1	VP	1-5
Marysland	SIL	0-1	P	1-5
Zahl	L	3-25	W	1-5

* SL, sandy loam;L, loam; SIL, silt loam
** VP, very poor;P, poor;W, well

Description

These soil areas consist of level to hilly topography with plains, hills, and ridges. Poorly and very poorly drained soils occupy depressions and drainageways. The dominant soils formed in glaciofluvial deposits and have sandy or gravelly substratums (fig. 4). Most level to gently rolling areas of this association are used for cultivated crops with steeper areas used for rangeland.

Wabek and Zahl soils occur on convex knolls and ridges. Appam and Lehr soils occur on side slopes and flats. Williams soils occur on plane side slopes. Parnell soils are very poorly drained and occupy depressions and potholes. The poorly drained Marysland soils occur in drainageways and on flats.

Major Limitations for Agricultural Use

Wind erosion and droughtiness, due to limited water holding capacity, are concerns on the dominant soils. The poorly and very poorly drained soils are generally wet or ponded in the spring and after heavy rains. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

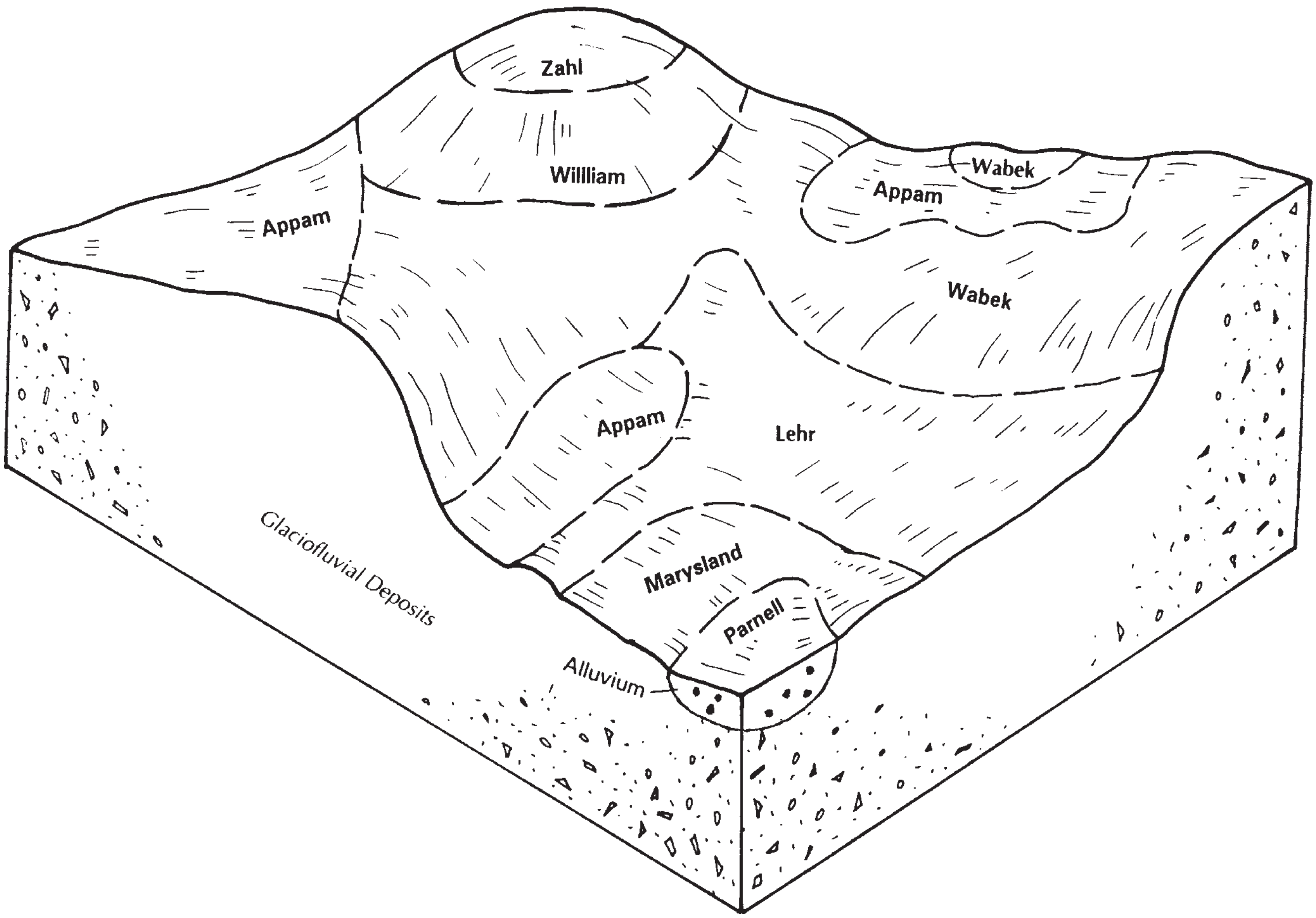

Figure 4. Typical pattern of soils and underlying material in the Wabek-Appam-Lehr association.

116—Stady-Lehr-Arnegard Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Stady	L	0-9	W	30-35
Lehr	L	0-9	W	25-30
Arnegard	L	0-6	W	15-20
MINOR COMPONENTS				
Belfield	L	0-3	W	10-15
Reeder	L	1-9	W	5-10
Hamerly	L	0-3	SP	5-10

* L, loam
** W, well;SP, somewhat poor

Description

These soil areas consist of level to gently rolling topography on stream terraces. The dominant soils formed in coarse to moderately-fine textured alluvium and glaciofluvial deposits. Most areas of this association are used for cultivated crops.

Stady soils occur on broad flats. Lehr soils occur on gentle rises on flats. The Stady and Lehr soils have a gravelly substratum. Arnegard soils occupy swales on flats and in drainageways. Belfield soils occupy swales on flats and lower side slopes. Reeder soils occur on convex side slopes and broad ridges. Hamerly soils occur in drainageways.

Major Limitations for Agricultural Use

Droughtiness, due to low water holding capacity, is a concern on some dominant soils. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

140 —Dumps, mine-Ustorthents Association, level to very steep

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Dumps, mine	CL	0-75	W	55-60
Ustorthents	CL	0-60	W	25-30
MINOR COMPONENTS				
Harriet	L	0-1	P	1-5
Parnell	SICL	0-1	VP	1-5
Southam	SIL	0-1	VP	1-5

* L, loam; CL, clay loam; SIL, silt loam; SICL, silty clay loam
** VP, very poor; P, poor; W, well

Description

Dumps, mine and Ustorthents are areas from which lignite coal has been removed by surface strip-mining operations. Very steep, barren spoil banks and waste piles of soft shale, sandstone, and glacial till occur in these areas. Poorly and very poorly drained Harriet, Parnell and Southam soils are in depressions and swales and are intermingled with the spoil material. Most areas are used for wildlife habitat.

Major Limitations for Agricultural Use

Because of slope, very high surface runoff, low fertility, and wind and water erosion, few areas are used for agriculture. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

141—Williams-Niobell-Noonan Association, nearly level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Williams	L	1-6	W	25-30
Niobell	L	1-6	MW	15-20
Noonan	L	1-6	MW	15-20
MINOR COMPONENTS				
Tonka	SIL	0-1	P	10-15
Miranda	L	0-3	MW	5-10
Hamerly	L	0-3	SP	5-10
Zahl	L	6-15	W	5-10

* L, loam;SIL, silt loam
** SP, somewhat poor; P, poor;W, moderately well;W, well

Description

These soil areas consist of numerous low, irregularly-shaped knolls with intervening swales, drainageways, and poorly drained depressions. The dominant soils formed in medium textured glacial till. Most areas are used for cropland.

The Williams soils are on gentle convex side slopes and broad, convex crests of rises. The Niobell and Noonan soils are intermingled with the Williams soils (fig 5). Tonka soils occur in depressions. Miranda soils are on low-lying flats. Hamerly soils occur on gentle convex positions adjacent to depressions and on flats. Zahl soils are on sloping convex rises. The Niobell, Noonan, and Miranda soils are sodium affected. The Hamerly and Zahl soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Water erosion may be a limitation on the dominant soils. The sodium-affected soils may have limited root and water penetration. Wind erosion is a concern on the high lime soils. Portions of these areas have periods of wetness and ponding in spring and after heavy rainfall. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

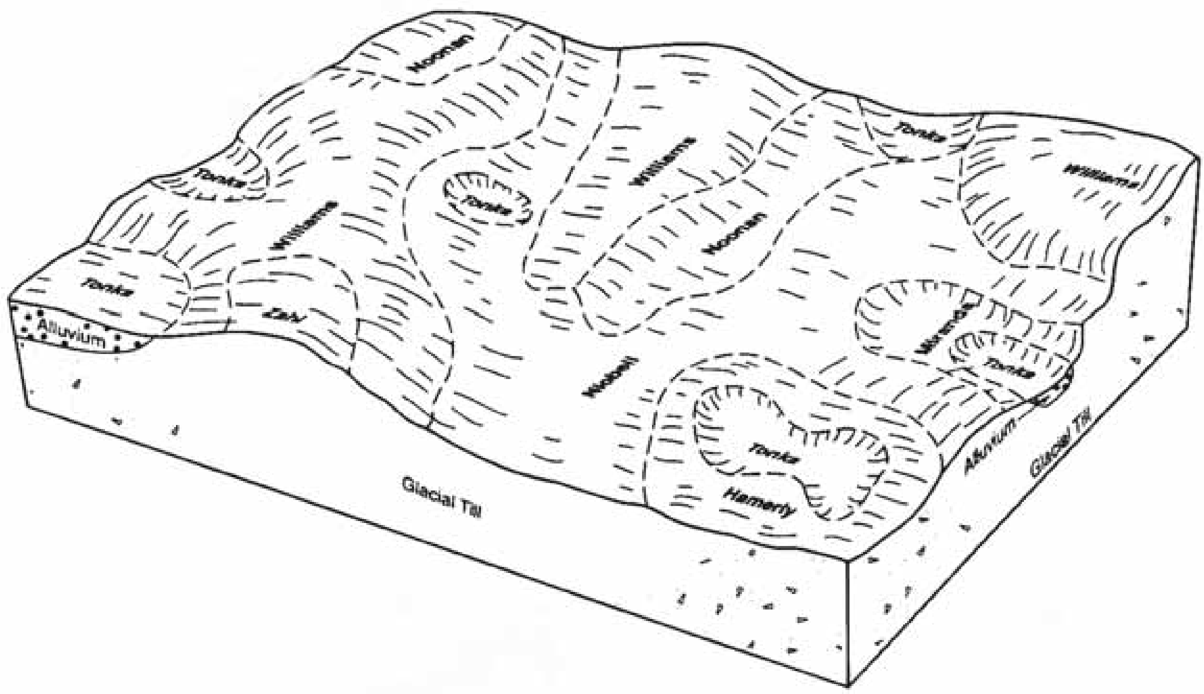

Figure 5. Typical pattern of soils and underlying material in the Williams-Niobell-Noonan association.

142—Noonan-Niobell Association, nearly level and undulating

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Noonan	L	1-6	MW	30-35
Niobell	L	1-6	MW	25-30
MINOR COMPONENTS				
Williams	L	1-6	W	10-15
Tonka	SIL	0-1	P	5-10
Miranda	L	0-3	MW	5-10
Hamerly	L	0-3	SP	5-10
Harriet	L	0-1	P	1-5

* L, loam; SIL, silt loam
** SP, somewhat poor; P, poor; MW, moderately well; W, well

Description

These soil areas consist of numerous low, irregularly-shaped rises separated by shallow swales and poorly drained depressions. The soils formed in medium textured glacial till. Most areas are used for cropland.

The Noonan and Niobell soils are on gentle convex side slopes and broad, convex crests of rises (fig. 6). The Williams soils are intermingled with the Noonan and Niobell soils. Tonka soils occur in depressions. Miranda and Harriet soils are on low-lying flats. Hamerly soils occur on gentle convex positions adjacent to depressions and on flats. The Harriet, Miranda, Niobell, and Noonan soils are sodium affected. The Hamerly soils have a prominent “high lime” layer which is within plow depth in many areas. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind erosion, salinity, and wetness are concerns on the dominant soils. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

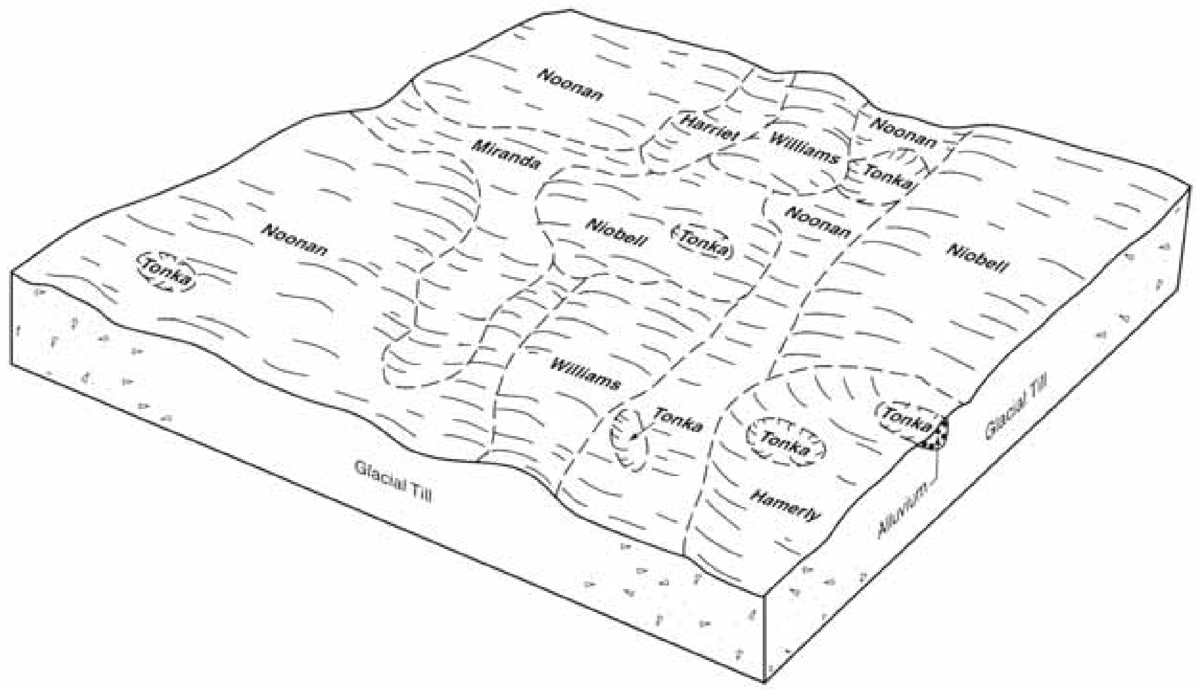

Figure 6. Typical pattern of soils and underlying material in the Noonan-Niobell association.

149—Dooley-Parshall Association, level to rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Dooley	FSL	0-12	W	65-70
Parshalll	FSL	2-6	W	15-20
MINOR COMPONENTS				
Lihen	LFS	0-6	W	5-10
Tally	SL	2-6	W	1-5
Trembles	FSL	0-2	W	1-5
Blanchard	LS	3-12	E	1-5

* LFS, loamy fine sand; LS, loamy sand; SL, sandy loam; FSL, fine sandy loam
** W, well; E, excessive

Description

These soil areas consist of nearly level to rolling topography with irregularly-shaped knolls separated by concave swales and drainageways. The dominant soils formed in moderately coarse to moderately fine textured glacial till and alluvium. Most areas of this association are used for cultivated crops.

Dooley soils occur on flats, side slopes, and summits. They formed in moderately coarse eolian material over medium textured glacial till. Parshall and Tally soils occur on lower side slopes and in swales. Lihen and Blanchard soils are sandy throughout and occur on upper side slopes of knolls. Trembles soils occur on flood plains.

Major Limitations for Agricultural Use

Wind erosion is a major concern on these areas. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations for agriculture see Table 6.

169—Zahl-Williams Association, undulating to very steep

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Zahl	L	3-45	W	50-55
Williams	L	3-15	W	35-40
MINOR COMPONENTS				
Parnell	SICL	0-1	VP	5-10
Niobell	L	0-6	W	1-5
Wabek	L	6-25	E	1-5

* L, loam;SICL, silty clay loam
** VP, very poor;W, well;E, excessive

Description

These soil areas consist of undulating to very steep topography with knolls, ridges, an occasional drainageway, and some very poorly drained soils in depressions and potholes. The dominant soils formed in medium to moderately-fine textured glacial till (fig. 7). Most areas of this association are used for rangeland. Lower sloping areas are used for cultivated crops.

Zahl soils occur on convex slopes of knolls and ridges. Williams soils occur on side slopes and summits. The very poorly drained Parnell soils occupy depressions and potholes. Niobell soils occur on concave side slopes and have a sodic subsoil. Wabek soils occur on knolls and some ridges. They have a gravelly substratum that restricts root growth.

Major Limitations for Agricultural Use

Water erosion is a concern on the dominant soils. Steep slopes and potholes limit use for cultivated crops in some areas. For additional information concerning these soils see "Detailed Map Unit Descriptions" and "Series Descriptions." For information concerning the limitations for agriculture see Table 6.

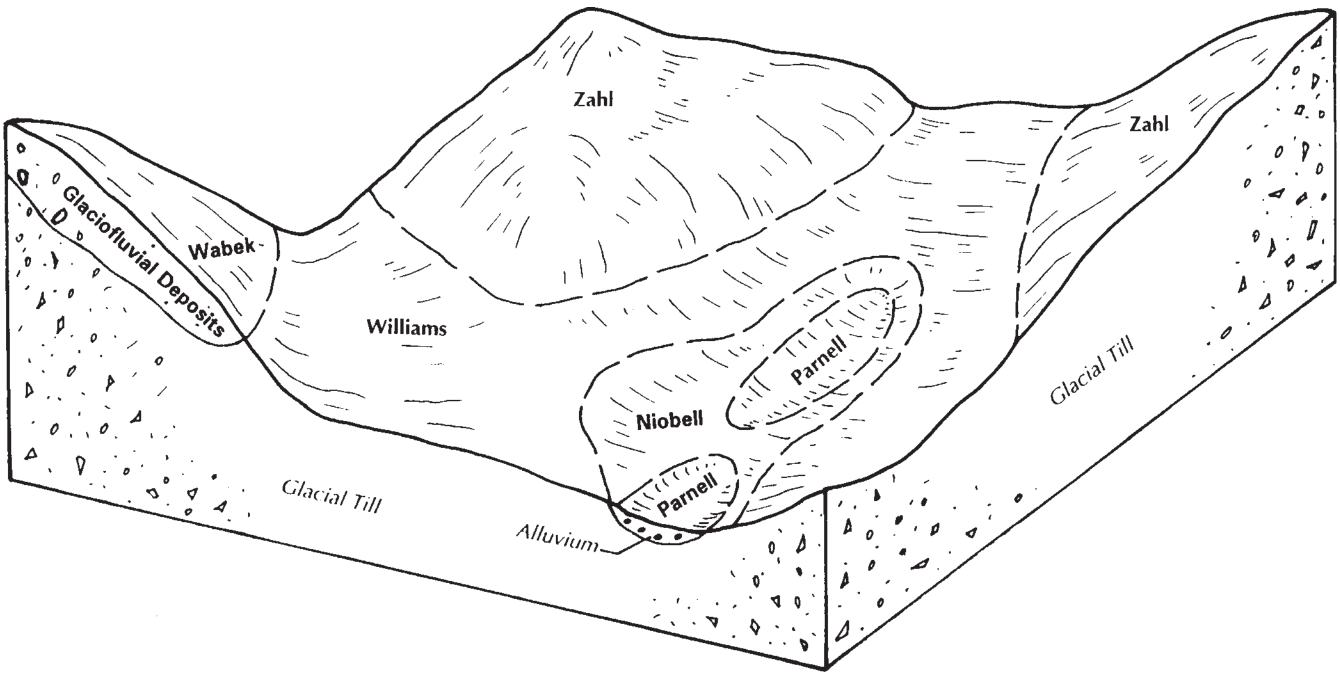

Figure 7. Typical pattern of soils and underlying material in the Zahl-Williams association.

171—Farnuf-Marias-Alkabo Association, level to gently rolling

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Farnuf	L	0-9	W	40-45
Marias	SIC	0-6	W	20-25
Alkabo	SIL	0-3	W	10-15
MINOR COMPONENTS				
Parnell	SICL	0-1	VP	5-10
Sakakawea	L	3-9	W	5-10
Appam	SL	0-6	SE	1-5
Hamerly	L	0-3	SP	1-5

* SL, sandy loam; L, loam; SIL, silt loam; SICL, silty clay loam; SIC, silty clay
** VP, very poor; SP, somewhat poor; W, well; SE, somewhat excessive

Description

These soil areas consist of level to gently rolling topography. The dominant soils formed in medium to fine textured glacial lake plains. Most areas of this association are used for cultivated crops.

Farnuf and Marias soils occur on gentle convex side slopes and broad flats. Alkabo soils occupy the swales and lower side slopes. They have a root limiting layer. Parnell soils occur in depressions and potholes. Sakakawea soils occupy the convex ridges and knolls. Appam soils occur on lower side slopes surrounding the glacial lake plains. Hamerly soils occur on flats adjacent to depressions. The Hamerly and Sakakawea soils have a prominent “high lime” layer which occurs within plow depth on many of the rises. This light-colored, limy material often is exposed and mixed with dark surface soil by cultivation.

Major Limitations for Agricultural Use

Wind and water erosion are concerns on some soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations for agriculture see Table 6.

172—Harriet-Miranda-Stirum Association, level and nearly level

	SURFACE TEXTURE*	SLOPE PERCENT	DRAINAGE**	PERCENT COMPOSITION
MAJOR COMPONENTS				
Harriet	L	0-1	P	25-30
Miranda	L	0-3	SP	15-20
Stirum	L	0-1	P	15-20
MINOR COMPONENTS				
Noonan	L	0-6	W	15-20
Appam	SL	1-6	SE	1-5
Williams	L	3-6	W	1-5
Southam	SIL	0-1	VP	1-5

* SL, sandy loam; L, loam; SIL, silt loam
** VP, very poor; SP, somewhat poor; P, poor; W, well; SE, somewhat excessive

Description

These soil areas consist of level and nearly level bottom lands of streams and outwash channels. The dominant soils formed in medium to fine textured alluvium. The dominant soils are sodium affected with areas of accumulated salts. Most areas of this association are used for hay or rangeland.

Harriet and Stirum soils occur along channels and on flood plains. They are poorly drained. Miranda soils occur on higher flood plains and terraces. Noonan and Williams soils occur on side slopes adjacent to the channels. They formed in glacial till. Appam soils are somewhat excessively drained and occur on terraces. Southam soils are very poorly drained and occur in depressions. Harriet, Stirum, Noonan, and Miranda soils have a root restrictive layer.

Major Limitations for Agricultural Use

Wind erosion, flooding, and limited available water capacity are concerns on some of these soils. For additional information concerning these soils see “Detailed Map Unit Descriptions” and “Series Descriptions.” For information concerning the limitations for agriculture see Table 6.

Detailed Soil Map Units

Map units on the detailed soil maps represent soils or miscellaneous areas in the survey area. The map unit descriptions in this section, along with the soil maps and interpretive tables, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses.

A map unit delineation on the detailed soil maps represents an area on the landscape and consists of one or more soils or miscellaneous areas. The soils or miscellaneous areas are called map unit components. The map unit descriptions in this section describe the setting of the map unit or where on the landscape named map unit components can be found. The composition, or the proportion, of various soils or miscellaneous areas of a map unit determine how a map unit is named.

A map unit is identified according to the taxonomic classification of the dominant soils or miscellaneous areas. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, soils and miscellaneous areas are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some included areas that belong to other taxonomic classes.

Most included soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called similar soils. They may or may not be mentioned in the map unit description. Other included soils and miscellaneous areas, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting or dissimilar soils. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. Included soils or miscellaneous areas are mentioned in the map unit descriptions. Soil interpretations in this manuscript are for named map unit components only.

A few included areas may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of included areas in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but if intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

The map unit descriptions on the following pages give a range in composition for the named map unit components and similar soils. They also give the average component composition of named, similar, and dissimilar soils.

Soils that have profiles that are almost alike make up a soil series. Except for minor differences in texture of the surface layer or underlying layers, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of underlying layers. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Marias silty clay, 0 to 3 percent slopes, is one of the phases of the Marias series.

A complex consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Vallers-Parnell complex, 0 to 1 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Harriet, Regan, and Stirum soils, 0 to 1 percent slopes, is an undifferentiated group in this survey area.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by special symbols on the soil maps.

The map unit descriptions on the following pages give information on each named component. Information such as slope, drainage class, and depth to restrictive feature is included. There is also information concerning the management of the map unit.

An identifying symbol precedes the map unit name in each map unit description. This symbol is used to identify delineations on the soil maps.

Table 4, “Acreage and Proportionate Extent of the Soils,” gives the acreage and proportionate extent of each map unit in the survey area. Additional information about each named component and map unit inclusion can be found in “Soil Series and Their Morphology.” Hydric soils information can be found in the section “Hydric Soils.” Table 24 “Hydric Soil List” indicates the map unit components with hydric conditions. Other tables give properties of the soils and the limitations, capabilities, and potentials for many uses. The “Glossary” defines many of the terms used in describing the soils or miscellaneous areas.

110—Barnes loam, 0 to 3 percent slopes

Setting:

Barnes soils are on slight rises on till plains.

Map Unit Composition (percent)

Named Components

Barnes and similar soils: 65 to 85 percent

Average Component Composition

Barnes: 72 percent
Cresbard: 10 percent
Svea: 8 percent
Swenoda: 7 percent
Hamerly: 2 percent
Tonka: 1 percent

Named Component Description

Barnes

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 7 inches; loam
Bw-7 to 19 inches; loam
Bk-19 to 37 inches; loam
C-37 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

111—Barnes loam, 3 to 6 percent slopes

Setting:

Barnes soils are on rises on till plains.

Map Unit Composition (percent)

Named Components

Barnes and similar soils: 45 to 70 percent

Average Component Composition

Barnes: 62 percent
Buse: 23 percent
Svea: 6 percent
Swenoda: 4 percent
Cresbard: 2 percent
Vallers: 2 percent
Tonka: 1 percent

Named Component Description

Barnes

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 7 inches; loam
Bw-7 to 19 inches; loam
Bk-19 to 37 inches; loam
C-37 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

120—Barnes-Buse loams, 6 to 9 percent slopes

Setting:

Barnes soils are on backslopes and summits. Buse soils are on shoulder slopes. These soils are on rises on till plains.

Map Unit Composition (percent)

Named Components

Barnes and similar soils: 40 to 65 percent
Buse and similar soils: 30 to 55 percent

Average Component Composition

Barnes: 53 percent
Buse: 45 percent
Hamerly: 1 percent
Tonka: 1 percent

Named Component Description

Barnes

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 7 inches; loam
Bw-7 to 19 inches; loam
Bk-19 to 37 inches; loam
C-37 to 60 inches; loam

Buse

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 8 inches; loam
Bk-8 to 40 inches; loam
C-40 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

470—Cresbard-Barnes loams, 0 to 3 percent slopes

Setting:

Cresbard soils are on flats. Barnes soils are on slight rises. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Cresbard and similar soils: 35 to 60 percent
Barnes and similar soils: 15 to 40 percent

Average Component Composition

Cresbard: 49 percent
Barnes: 24 percent
Hamlet: 15 percent
Tonka: 3 percent
Wyard: 3 percent
Cavour: 2 percent
Parnell: 2 percent
Vallers: 2 percent

Named Component Description

Cresbard

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 19 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 9 inches; loam
E/B-9 to 14 inches; clay loam
Btn-14 to 34 inches; silty clay
Bk-34 to 55 inches; clay loam
C-55 to 60 inches; clay loam

Barnes

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 7 inches; loam
Bw-7 to 19 inches; loam
Bk-19 to 37 inches; loam
C-37 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

674— Farnuf loam, 0 to 3 percent slopes

Setting:

Farnuf soils occur on flats on lake plains.

Map Unit Composition (percent)

Named Components

Farnuf and similar soils: 65 to 85 percent

Average Component Composition

Farnuf: 75 percent
Sakakawea: 9 percent
Roseglen: 8 percent
Hamerly: 3 percent
Lehr: 2 percent
Marias: 2 percent
Tonka: 1 percent

Named Component Description

Farnuf

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected

Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bt-9 to 23 inches; clay loam
Bk-23 to 34 inches; loam
BC-34 to 60 inches; stratified fine sandy loam to silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

676—Farnuf-Sakakawea loams, 3 to 6 percent slopes

Setting:

Farnuf soils are on flats. Sakakawea soils are on rises. These soils are on lake plains.

Map Unit Composition (percent)

Named Components

Farnuf and similar soils: 40 to 65 percent
Sakakawea and similar soils: 15 to 40 percent

Average Component Composition

Farnuf: 55 percent
Sakakawea: 28 percent
Marias: 6 percent
Roseglen: 6 percent
Niobell: 2 percent
Hamerly: 1 percent
Vallers: 1 percent
Williams: 1 percent

Named Component Description

Farnuf

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bt-9 to 23 inches; clay loam
Bk-23 to 34 inches; loam
BC-34 to 60 inches; stratified fine sandy loam to silty clay loam

Sakakawea

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bk-6 to 21 inches; silt loam
C1-21 to 41 inches; silt loam
C2-41 to 60 inches; stratified loamy sand to silty clay

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

882—Hamerly-Tonka complex, 0 to 3 percent slopes

Setting:

Hamerly soils are on convex rises. Tonka soils are in shallow concave depressions. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Hamerly and similar soils: 30 to 50 percent
Tonka and similar soils: 25 to 45 percent

Average Component Composition

Hamerly: 46 percent
Tonka: 31 percent
Parnell: 12 percent
Vallers: 5 percent
Bowbells: 3 percent
Divide: 2 percent
Niobell: 1 percent

Named Component Description

Hamerly

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 8 inches; loam
Bk-8 to 35 inches; loam
C-35 to 60 inches; loam

Tonka

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 13 inches; silt loam
E-13 to 19 inches; loam
Bt-19 to 34 inches; silty clay loam
2BC-34 to 50 inches; clay loam
2Cg-50 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

975—Heil silt loam, 0 to 1 percent slopes

Setting:

Heil soils are in shallow depressions.

Map Unit Composition (percent)

Named Components

Heil and similar soils: 70 to 85 percent

Average Component Composition

Heil: 75 percent
Harriet: 9 percent
Exline: 4 percent
Tonka: 4 percent
Parnell: 3 percent
Vallers, saline: 3 percent
Noonan: 2 percent

Named Component Description

Heil

Slope: 0 to 1 percent
Depth to Restrictive Feature: Natric; top depth ranges from 1 to 4 inches
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Saline within 30 inches
Sodium Affected: Sodic within 30 inches
Typical profile:
E-0 to 3 inches; silt loam
Btn-3 to 24 inches; silty clay
Bg-24 to 38 inches; silty clay
Byg-38 to 52 inches; silty clay
Cg-52 to 60 inches; silty clay

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Pasture, hayland, or range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1267—Marysland loam, 0 to 1 percent slopes

Setting:

Marysland soils are in swales and channels on outwash plains.

Map Unit Composition (percent)

Named Components

Marysland and similar soils: 70 to 90 percent

Average Component Composition

Marysland: 76 percent
Easby: 8 percent
Vallers: 8 percent
Divide: 6 percent
McDonaldsville: 2 percent

Named Component Description

Marysland

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Ak-9 to 12 inches; loam
Bkg1-12 to 15 inches; loam
Bkg2-15 to 20 inches; loam
Bkg3-20 to 27 inches; loam
2Cg1-27 to 40 inches; stratified fine sand to gravelly coarse sand
2Cg2-40 to 60 inches; stratified fine sand to gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Pasture, hayland, or range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1427—Parnell silty clay loam, 0 to 1 percent slopes

Setting:

Parnell soils are in depressions on till plains.

Map Unit Composition (percent)

Named Components

Parnell and similar soils: 70 to 85 percent

Average Component Composition

Parnell: 76 percent
Vallers: 12 percent
Grano: 5 percent
Tonka: 3 percent
Heil: 2 percent
Miranda: 1 percent
Southam: 1 percent

Named Component Description

Parnell

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Very poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 15 inches; silty clay loam
A2-15 to 22 inches; silt loam
Btg1-22 to 32 inches; silty clay loam
Btg2-32 to 55 inches; silty clay
BCg-55 to 60 inches; silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Pasture, hayland, range, or wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1439—Parshall fine sandy loam, 0 to 6 percent slopes

Setting:

Parshall soils are on flats and rises of outwash plains.

Map Unit Composition (percent)

Named Components

Parshall and similar soils: 80 to 95 percent

Average Component Composition

Parshall: 83 percent
Dooley: 7 percent
Portal: 3 percent
Hamerly: 2 percent
Lihen: 2 percent
Niobell: 2 percent
Sakakawea: 1 percent

Named Component Description

Parshall

Slope: 0 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 12 inches; fine sandy loam
Bw-12 to 29 inches; fine sandy loam
Bk-29 to 48 inches; fine sandy loam
BCk-48 to 60 inches; loamy fine sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1466—Pits, sand and gravel

Setting:

Gravel and sand pits are on terraces of outwash plains and river valleys.

Map Unit Composition (percent)

Named Components

Pits, sand and gravel, and similar soils: 70 to 90 percent

Average Component Composition

Pits, sand and gravel: 80 percent
Wabek: 10 percent
Bowdle: 5 percent
Lehr: 5 percent

Named Component Description

Pits, sand and gravel

Slope: 0 to 60 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
H1-0 to 6 inches; extremely gravelly sand
H2-6 to 60 inches; extremely gravelly sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Engineering material

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1709—Southam silt loam, 0 to 1 percent slopes

Setting:

Southam soils are in depressions on till plains.

Map Unit Composition (percent)

Named Components

Southam and similar soils: 70 to 90 percent

Average Component Composition

Southam: 81 percent
Parnell: 7 percent
Heil: 6 percent
Minnewaukan: 4 percent
Tonka: 2 percent

Named Component Description

Southam

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Very poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Saline within 30 inches
Sodium Affected: Not affected
Typical profile:
Ag1-0 to 16 inches; silt loam
Ag2-16 to 40 inches; silty clay
Cg-40 to 60 inches; silty clay

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1739—Straw loam, 0 to 3 percent slopes

Setting:

Straw soils are on flood plains.

Map Unit Composition (percent)

Named Components

Straw and similar soils: 70 to 90 percent

Average Component Composition

Straw: 78 percent
Parnell: 7 percent
Korchea: 5 percent
Velva: 5 percent
Miranda: 2 percent
Tonka: 2 percent
Vallers: 1 percent

Named Component Description

Straw

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Moderately well drained
Flooding: Rare
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 5 inches; loam
A1-5 to 23 inches; loam
A2-23 to 30 inches; loam
C-30 to 36 inches; clay loam
Ab-36 to 40 inches; clay loam
C’-40 to 66 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1835—Tonka silt loam, 0 to 1 percent slopes

Setting:

Tonka soils are in shallow depressions on till plains.

Map Unit Composition (percent)

Named Components

Tonka and similar soils: 70 to 90 percent

Average Component Composition

Tonka: 80 percent
Hamerly: 6 percent
Heil: 4 percent
Noonan: 4 percent
Parnell: 4 percent
Bowbells: 1 percent
Miranda: 1 percent

Named Component Description

Tonka

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 13 inches; silt loam
E-13 to 19 inches; loam
Bt-19 to 34 inches; silty clay loam
2BC-34 to 50 inches; clay loam
2Cg-50 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland, pasture, or hayland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1871—Vallers loam, saline, 0 to 1 percent slopes

Setting:

Vallers soils are on flats between depressions and along channels on till plains.

Map Unit Composition (percent)

Named Components

Vallers, saline and similar soils: 50 to 70 percent

Average Component Composition

Vallers, saline: 62 percent
Hamerly, saline: 10 percent
Hegne, saline: 8 percent
Parnell: 7 percent
Hamlet: 5 percent
Harriet: 5 percent
Divide, saline: 3 percent

Named Component Description

Vallers, saline

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bkg-9 to 44 inches; clay loam
BCg-44 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Pasture, hayland, or rangeland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1883—Vallers-Parnell complex, 0 to 1 percent slopes

Setting:

Vallers soils are on flats. Parnell soils are in depressions. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Vallers and similar soils: 35 to 55 percent
Parnell and similar soils: 20 to 40 percent

Average Component Composition

Vallers: 45 percent
Parnell: 30 percent
Hamerly: 9 percent
Divide: 5 percent
Harriet: 3 percent
Southam: 3 percent
Tonka: 3 percent
Williams: 2 percent

Named Component Description

Vallers

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bkg-9 to 44 inches; clay loam
BCg-44 to 60 inches; clay loam

Parnell

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Very poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 15 inches; silty clay loam
A2-15 to 22 inches; silt loam
Btg1-22 to 32 inches; silty clay loam
Btg2-32 to 55 inches; silty clay
BCg-55 to 60 inches; silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Pasture, hayland, range, and wetland wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

1978—Water

Setting:

Water is found in lakes and large deep depressions.

Map Unit Composition (percent)

Named Components

Water and similar soils: 90 percent

Average Component Composition

Water: 90 percent
Colvin, poorly drained: 5 percent
Southam: 5 percent

Named Component Description

Definition: Areas, including ponds, lakes, streams, and reservoirs, that are covered with water in most years during the period that is warm enough for plants to grow or longer.

Management

For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2014—Williams-Bowbells loams, 0 to 3 percent slopes

Setting:

Williams soils are on backslopes of rises. Bowbells soils are in swales. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 50 to 80 percent
Bowbells and similar soils: 10 to 35 percent

Average Component Composition

Williams: 66 percent
Bowbells: 22 percent
Niobell: 7 percent
Appam: 1 percent
Bowdle: 1 percent
Hamerly: 1 percent
Tonka: 1 percent
Zahl: 1 percent

Named Component Description

Williams

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Bowbells

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 6 inches; loam
Bt1-6 to 14 inches; clay loam
Bt2-14 to 23 inches; clay loam
Bk-23 to 36 inches; loam
C-36 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2015—Williams-Bowbells loams, 3 to 6 percent slopes

Setting:

Williams soils are on backslopes and summits of rises. Bowbells soils are in swales. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 35 to 60 percent
Bowbells and similar soils: 25 to 50 percent

Average Component Composition

Williams: 50 percent
Bowbells: 37 percent
Parnell: 5 percent
Niobell: 3 percent
Zahl: 2 percent
Hamerly: 1 percent
Tonka: 1 percent
Vallers: 1 percent

Named Component Description

Williams

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Bowbells

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 6 inches; loam
Bt1-6 to 14 inches; clay loam
Bt2-14 to 23 inches; clay loam
Bk-23 to 36 inches; loam
C-36 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2023—Williams-Niobell loams, 0 to 3 percent slopes

Setting:

Williams soils are on flats. Niobell soils are in swales. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 30 to 60 percent
Niobell and similar soils: 30 to 55 percent

Average Component Composition

Williams: 45 percent
Niobell: 41 percent
Noonan: 5 percent
Bowbells: 3 percent
Tonka: 2 percent
Zahl: 2 percent
Dooley: 1 percent
Heil: 1 percent

Named Component Description

Williams

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Niobell

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 17 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
B/E-6 to 9 inches; loam
Btn-9 to 19 inches; clay loam
Bky-19 to 29 inches; clay loam
C-29 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2024—Williams-Niobell loams, 3 to 6 percent slopes

Setting:

Williams soils are on rises. Niobell soils are in swales. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 30 to 55 percent
Niobell and similar soils: 25 to 55 percent

Average Component Composition

Williams: 43 percent
Niobell: 34 percent
Zahl: 7 percent
Bowbells: 6 percent
Noonan: 6 percent
Heil: 2 percent
Hamerly: 1 percent
Tonka: 1 percent

Named Component Description

Williams

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Niobell

Slope: 3 to 6 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 17 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
B/E-6 to 9 inches; loam
Btn-9 to 19 inches; clay loam
Bky-19 to 29 inches; clay loam
C-29 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2031—Williams-Zahl loams, 3 to 6 percent slopes

Setting:

Williams soils are on backslopes and summits. Zahl soils are on shoulder slopes. These soils are on knolls and ridges on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 40 to 70 percent
Zahl and similar soils: 15 to 40 percent

Average Component Composition

Williams: 50 percent
Zahl: 27 percent
Niobell: 7 percent
Bowbells: 5 percent
Dooley: 5 percent
Tonka: 3 percent
Hamerly: 2 percent
Vallers: 1 percent

Named Component Description

Williams

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None

Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Zahl

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2081—Zahl-Williams loams, 9 to 15 percent slopes

Setting:

Zahl soils are on shoulder slopes. Williams soils are on backslopes and summits. These soils are on knolls and ridges of till plains.

Map Unit Composition (percent)

Named Components

Zahl and similar soils: 40 to 65 percent
Williams and similar soils: 25 to 50 percent

Average Component Composition

Zahl: 55 percent
Williams: 33 percent
Bowbells: 6 percent
Niobell: 2 percent
Hamerly: 1 percent
Marias: 1 percent
Parnell: 1 percent
Wabek: 1 percent

Named Component Description

Zahl

Slope: 9 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Williams

Slope: 9 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Range or cropland (fig. 8)

For cropland limitations and hazards see Table 6. For

Figure 8. Cattle grazing on an area of Zahl-Williams loams, 9 to 15 percent slopes.

information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2130—Williams-Zahl-Parnell complex, 0 to 9 percent slopes

Setting:

Williams soils are on backslopes and summits. Zahl soils are on shoulder slopes. Parnell soils are in depressions. The Williams and Zahl soils are on knolls and ridges. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 20 to 40 percent
Zahl and similar soils: 20 to 40 percent
Parnell and similar soils: 15 to 35 percent

Average Component Composition

Williams: 32 percent
Zahl: 28 percent
Parnell: 18 percent
Tonka: 5 percent
Hamerly: 4 percent
Vallers: 4 percent
Heil: 3 percent
Noonan: 3 percent
Southam: 3 percent

Named Component Description

Williams

Slope: 1 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Zahl

Slope: 3 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam

Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Parnell

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Very poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 15 inches; silty clay loam
A2-15 to 22 inches; silt loam
Btg1-22 to 32 inches; silty clay loam
Btg2-32 to 55 inches; silty clay
BCg-55 to 60 inches; silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Range or cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2131—Zahl-Williams-Parnell complex, 0 to 35 percent slopes

Setting:

Zahl soils are on shoulder slopes. Williams soils are on backslopes and summits. Parnell soils are in depressions. Zahl and Williams soils are on knolls and ridges. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Zahl and similar soils: 25 to 50 percent
Williams and similar soils: 15 to 35 percent
Parnell and similar soils: 15 to 35 percent

Average Component Composition

Zahl: 37 percent
Williams: 24 percent
Parnell: 20 percent
Hamerly: 5 percent
Vallers: 5 percent
Southam: 4 percent
Bowbells: 3 percent
Tonka: 2 percent

Named Component Description

Zahl

Slope: 9 to 35 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Williams

Slope: 9 to 35 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Parnell

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Very poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 15 inches; silty clay loam
A2-15 to 22 inches; silt loam

Btg1-22 to 32 inches; silty clay loam
Btg2-32 to 55 inches; silty clay
BCg-55 to 60 inches; silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2169—Harriet, Regan, and Stirum soils, 0 to 1 percent slopes

Setting:

These soils are in drainageway and on flood plains of uplands. (fig. 9)

Map Unit Composition (percent)

Named Components

Harriet and similar soils: 0 to 90 percent
Regan and similar soils: 0 to 90 percent
Stirum and similar soils: 0 to 90 percent

Average Component Composition

Harriet: 28 percent
Regan: 28 percent
Stirum: 28 percent
Miranda: 7 percent
Heil: 4 percent
Tiffany: 2 percent
Exline: 1 percent
Noonan: 1 percent
Portal: 1 percent

Named Component Description

Harriet

Slope: 0 to 1 percent
Depth to Restrictive Feature: Natric; top depth ranges from 0 to 5 inches
Drainage Class: Poorly drained
Flooding: Occasional
Water Table: Seasonal
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Sodic within 30 inches
Typical profile:
E-0 to 2 inches; silt loam
Btn-2 to 18 inches; clay loam
Bz1-18 to 28 inches; loam
2Bz2-28 to 38 inches; very fine sandy loam
3Ab-38 to 40 inches; clay loam
3C-40 to 60 inches; stratified very fine sandy loam to silty clay

Regan

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: Occasional
Water Table: Seasonal
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; silt loam
Bkg-9 to 28 inches; silty clay loam
2Cg-28 to 60 inches; stratified sandy loam to silty clay loam

Stirum

Slope: 0 to 1 percent
Depth to Restrictive Feature: Natric; top depth ranges from 3 to 13 inches
Drainage Class: Poorly drained
Flooding: Occasional
Water Table: Seasonal
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 7 inches; fine sandy loam
Btn-7 to 15 inches; fine sandy loam
Bk-15 to 26 inches; loam
Bg-26 to 34 inches; very fine sandy loam
Bkg-34 to 44 inches; silt loam
2Cg-44 to 60 inches; loamy fine sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Range

Figure 9. An area of Harriet, Regan, and Stirum soils, 0 to 1 percent slopes.

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2170—Divide loam, 0 to 3 percent slopes

Setting:

Divide soils are on flats, terraces and in drainageways on uplands.

Map Unit Composition (percent)

Named Components

Divide and similar soils: 55 to 75 percent

Average Component Composition

Divide: 65 percent
Wyrene: 19 percent
Bowdle: 6 percent
Appam: 4 percent
Marysland: 3 percent
Hamerly: 2 percent
Wabek: 1 percent

Named Component Description

Divide

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 8 inches; loam
Ak-8 to 12 inches; loam
Bk-12 to 22 inches; loam
2C1-22 to 26 inches; gravelly loamy coarse sand
2C2-26 to 60 inches; very gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2171—Sakakawea-Farnuf loams, 6 to 9 percent slopes

Setting:

Sakakawea soils are on shoulder slopes of knolls and rises. Farnuf soils are on flats. These soils are on lake plains.

Map Unit Composition (percent)

Named Components

Sakakawea and similar soils: 50 to 65 percent
Farnuf and similar soils: 25 to 40 percent

Average Component Composition

Sakakawea: 60 percent
Farnuf: 27 percent
Roseglen: 5 percent
Williams: 4 percent
Marias: 2 percent
Lehr: 1 percent
Wabek: 1 percent

Named Component Description

Sakakawea

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bk-6 to 21 inches; silt loam
C1-21 to 41 inches; silt loam
C2-41 to 60 inches; stratified loamy sand to silty clay

Farnuf

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bt-9 to 23 inches; clay loam
Bk-23 to 34 inches; loam
BC-34 to 60 inches; stratified fine sandy loam to silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2172—Sakakawea-Farnuf loams, 9 to 25 percent slopes

Setting:

Sakakawea soils are on backslopes. Farnuf soils are on summits and footslopes. These soils are on knolls on lake plains.

Map Unit Composition (percent)

Named Components

Sakakawea and similar soils: 45 to 70 percent
Farnuf and similar soils: 20 to 35 percent

Average Component Composition

Sakakawea: 55 percent
Farnuf: 27 percent
Wabek: 11 percent

Marias: 4 percent
Zahl: 2 percent
Bryant: 1 percent

Named Component Description

Sakakawea

Slope: 9 to 25 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bk-6 to 21 inches; silt loam
C1-21 to 41 inches; silt loam
C2-41 to 60 inches; stratified loamy sand to silty clay

Farnuf

Slope: 9 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bt-9 to 23 inches; clay loam
Bk-23 to 34 inches; loam
BC-34 to 60 inches; stratified fine sandy loam to silty clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2173—Marias silty clay, 0 to 3 percent slopes

Setting:

Marias soils are on flats on lake plains.

Map Unit Composition (percent)

Named Components

Marias and similar soils: 60 to 85 percent

Average Component Composition

Marias: 73 percent
Farnuf: 11 percent
Wildrose: 10 percent
Aberdeen: 2 percent
Sakakawea: 2 percent
Grano: 1 percent
Hamerly: 1 percent

Named Component Description

Marias

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; silty clay
Bw-6 to 11 inches; clay
Bss-11 to 27 inches; clay
Bssy-27 to 60 inches; clay

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2174—Marias silty clay, 3 to 6 percent slopes

Setting:

Marias soils are on slight rises on lake plains.

Map Unit Composition (percent)

Named Components

Marias and similar soils: 60 to 85 percent

Average Component Composition

Marias: 75 percent
Farnuf: 14 percent
Sakakawea: 6 percent
Krem: 2 percent
Williams: 2 percent
Makoti: 1 percent

Named Component Description

Marias

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; silty clay
Bw-6 to 11 inches; clay
Bss-11 to 27 inches; clay
Bssy-27 to 60 inches; clay

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2175—Zahl-Williams loams, 6 to 9 percent slopes

Setting:

Zahl soils are on shoulder slopes. Williams soils are on summits and backslopes. These soils are on knolls and ridges on till plains.

Map Unit Composition (percent)

Named Components

Zahl and similar soils: 35 to 60 percent
Williams and similar soils: 30 to 50 percent

Average Component Composition

Zahl: 48 percent
Williams: 39 percent
Bowbells: 6 percent
Tonka: 3 percent
Hamerly: 2 percent
Niobell: 1 percent
Parnell: 1 percent

Named Component Description

Zahl

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Williams

Slope: 6 to 9 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam

Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2176—Zahl-Williams loams, 15 to 60 percent slopes

Setting:

Zahl soils are on shoulder slopes. Williams soils are on backslopes and summits. These soils are on ridges on till plains.

Map Unit Composition (percent)

Named Components

Zahl and similar soils: 45 to 60 percent
Williams and similar soils: 15 to 45 percent

Average Component Composition

Zahl: 52 percent
Williams: 31 percent
Bowbells: 8 percent
Wabek: 4 percent
Noonan: 2 percent
Hamerly: 1 percent
Marias: 1 percent
Niobell: 1 percent

Named Component Description

Zahl

Slope: 15 to 60 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Williams

Slope: 15 to 35 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Range

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2177—Zahl-Williams-Vallers loams, 0 to 60 percent slopes

Setting:

Zahl soils are on shoulder slopes. Williams soils are on backslopes and summits. Vallers soils are on flats and along drainageways. The Zahl and Williams soils are on ridges. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Zahl and similar soils: 20 to 40 percent
Williams and similar soils: 15 to 35 percent
Vallers and similar soils: 10 to 20 percent

Average Component Composition

Zahl: 30 percent
Williams: 23 percent
Vallers: 13 percent
Hamerly: 8 percent
Tonka: 8 percent
Bowbells: 6 percent
Wabek: 6 percent
Harriet: 3 percent
Southam: 3 percent

Named Component Description

Zahl

Slope: 15 to 60 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Williams

Slope: 15 to 35 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Vallers

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bkg-9 to 44 inches; clay loam
BCg-44 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Range and wildlife habitat

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2178—Farnuf-Alkabo silt loams, 0 to 3 percent slopes

Setting:

Farnuf soils are on flats. Alkabo soils are on rises. These soils are on lake plains.

Map Unit Composition (percent)

Named Components

Farnuf and similar soils: 30 to 60 percent
Alkabo and similar soils: 30 to 55 percent

Average Component Composition

Farnuf: 45 percent
Alkabo: 42 percent
Noonan: 5 percent
Hamerly: 2 percent
Niobell: 2 percent
Sakakawea: 2 percent
Makoti: 1 percent
Tonka: 1 percent

Named Component Description

Farnuf

Slope: 0 to 3 percent

Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 9 inches; loam
Bt-9 to 23 inches; clay loam
Bk-23 to 34 inches; loam
BC-34 to 60 inches; stratified fine sandy loam to silty clay loam
Note: Farnuf is a taxadjunct because it has a fine silty subsoil in this map unit.

Alkabo

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 18 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; silt loam
B/E-6 to 9 inches; silt loam
Btn-9 to 17 inches; silt loam
Bk-17 to 45 inches; silt loam
2C-45 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2179—Noonan-Niobell loams, 1 to 6 percent slopes

Setting:

The Noonan soils are on flats and in swales. The Niobell soils are on slight rises. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Noonan and similar soils: 40 to 60 percent
Niobell and similar soils: 20 to 40 percent

Average Component Composition

Noonan: 50 percent
Niobell: 29 percent
Williams: 8 percent
Miranda: 5 percent
Tonka: 3 percent
Hamerly: 2 percent
Heil: 2 percent
Parnell: 1 percent

Named Component Description

Noonan

Slope: 1 to 6 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 10 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
Btn1-6 to 9 inches; clay loam
Btn2-9 to 12 inches; clay loam
Bky1-12 to 20 inches; clay loam
Bky2-20 to 28 inches; clay loam
BCy-28 to 60 inches; clay loam

Niobell

Slope: 1 to 6 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 17 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
B/E-6 to 9 inches; loam
Btn-9 to 19 inches; clay loam

Bky-19 to 29 inches; clay loam
C-29 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6.
For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2180—Niobell-Noonan-Tonka complex, 0 to 3 percent slopes

Setting:

Niobell soils are on convex micro-highs of rises. Noonan soils are in concave micro-lows of flats. Tonka soils are in shallow depressions. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Niobell and similar soils: 25 to 50 percent
Noonan and similar soils: 20 to 45 percent
Tonka and similar soils: 15 to 40 percent

Average Component Composition

Niobell: 35 percent
Noonan: 24 percent
Tonka: 23 percent
Miranda: 6 percent
Parnell: 4 percent
Williams: 4 percent
Heil: 2 percent
Hamerly: 1 percent
Vallers: 1 percent

Named Component Description

Niobell

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 17 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
B/E-6 to 9 inches; loam
Btn-9 to 19 inches; clay loam
Bky-19 to 29 inches; clay loam
C-29 to 60 inches; loam

Noonan

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 10 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
Btn1-6 to 9 inches; clay loam
Btn2-9 to 12 inches; clay loam
Bky1-12 to 20 inches; clay loam
Bky2-20 to 28 inches; clay loam
BCy-28 to 60 inches; clay loam

Tonka

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Frequent
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 13 inches; silt loam
E-13 to 19 inches; loam
Bt-19 to 34 inches; silty clay loam
2BC-34 to 50 inches; clay loam
2Cg-50 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2181—Miranda-Noonan loams, 0 to 3 percent slopes

Setting:

Miranda soils are in micro-lows. Noonan soils are on micro-highs. These soils are on flats on till plains.

Map Unit Composition (percent)

Named Components

Miranda and similar soils: 35 to 60 percent
Noonan and similar soils: 15 to 35 percent

Average Component Composition

Miranda: 54 percent
Noonan: 25 percent
Niobell: 9 percent
Tonka: 5 percent
Hamerly: 2 percent
Parnell: 2 percent
Williams: 2 percent
Exline: 1 percent

Named Component Description

Miranda

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 0 to 5 inches
Drainage Class: Somewhat poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Sodic within 30 inches
Typical profile:
E-0 to 4 inches; loam
Btn-4 to 10 inches; clay loam
Btnz-10 to 16 inches; clay loam
Bkz-16 to 30 inches; clay loam
C-30 to 60 inches; clay loam

Noonan

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 5 to 10 inches
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; loam
Btn1-6 to 9 inches; clay loam
Btn2-9 to 12 inches; clay loam
Bky1-12 to 20 inches; clay loam
Bky2-20 to 28 inches; clay loam
BCy-28 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Rangeland, hayland, or cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2182—Portal-Lihen fine sandy loams, 0 to 3 percent slopes

Setting:

Portal soils are on flats. Lihen soils are on slight rises. These soils are on outwash plains.

Map Unit Composition (percent)

Named Components

Portal and similar soils: 30 to 50 percent
Lihen and similar soils: 25 to 50 percent

Average Component Composition

Portal: 39 percent
Lihen: 38 percent
Miranda: 5 percent

Niobell: 5 percent
Noonan: 5 percent
Parshall: 3 percent
Williams: 3 percent
Bowbells: 2 percent

Named Component Description

Portal

Slope: 0 to 3 percent
Depth to Restrictive Feature: Natric; top depth ranges from 0 to 12 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Sodic within 30 inches
Typical profile:
Ap-0 to 6 inches; fine sandy loam
E-6 to 8 inches; fine sand
Btn-8 to 12 inches; fine sandy loam
Btkn-12 to 22 inches; fine sandy loam
Bk-22 to 40 inches; fine sandy loam
BCk-40 to 60 inches; fine sandy loam

Lihen

Slope: 0 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 9 inches; fine sandy loam
A2-9 to 24 inches; loamy sand
Bk-24 to 32 inches; sand
C-32 to 60 inches; sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2183—Lihen-Blanchard loamy fine sands, 1 to 6 percent slopes

Setting:

Lihen soils are on flats. Blanchard soils are on rises. These soils are on outwash plains of uplands.

Map Unit Composition (percent)

Named Components

Lihen and similar soils: 55 to 75 percent
Blanchard and similar soils: 20 to 30 percent

Average Component Composition

Lihen: 62 percent
Blanchard: 22 percent
Dooley: 7 percent
Portal: 3 percent
Zahl: 3 percent
Kratka: 2 percent
Appam: 1 percent
Hamerly: 1 percent

Named Component Description

Lihen

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 9 inches; loamy fine sand
A2-9 to 24 inches; loamy sand
Bk-24 to 32 inches; sand
C-32 to 60 inches; sand

Blanchard

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None

Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 3 inches; loamy fine sand
C-3 to 60 inches; fine sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland or rangeland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2184—Williams-Zahl complex, 3 to 6 percent slopes

Setting:

Williams soils are on backslopes and summits. Zahl soils are on shoulder slopes. These soils are on rises of till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 45 to 70 percent
Zahl and similar soils: 15 to 40 percent

Average Component Composition

Williams: 47 percent
Zahl: 26 percent
Bowbells: 8 percent
Tally: 7 percent
Tonka: 5 percent
Lehr: 3 percent
Hamerly: 2 percent
Niobell: 2 percent

Named Component Description

Williams

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; sandy loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Zahl

Slope: 3 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2185—Williams-Zahl-Lihen complex, 6 to 15 percent slopes

Setting:

Williams and Lihen soils are on side slopes. Zahl soils are on shoulder slopes. These soils are on knolls on eolian mantled till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 25 to 50 percent
Lihen and similar soils: 15 to 35 percent
Zahl and similar soils: 10 to 30 percent

Average Component Composition

Williams: 39 percent
Lihen: 20 percent
Zahl: 19 percent
Parshall: 11 percent
Appam: 4 percent
Krem: 3 percent
Seroco: 3 percent
Farnuf: 1 percent

Named Component Description

Williams

Slope: 6 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; sandy loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Lihen

Slope: 6 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 9 inches; fine sandy loam
A2-9 to 24 inches; loamy sand
Bk-24 to 32 inches; sand
C-32 to 60 inches; sand

Zahl

Slope: 6 to 15 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 20 inches; loam
C-20 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2186—Lehr-Wabek loams, 1 to 3 percent slopes

Setting:

The Lehr soils are on backslopes. Wabek soils are on shoulder slopes. These soils are on rises of terraces on outwash plains of uplands.

Map Unit Composition (percent)

Named Components

Lehr and similar soils: 45 to 60 percent
Wabek and similar soils: 15 to 30 percent

Average Component Composition

Lehr: 53 percent
Wabek: 21 percent
Stady: 13 percent
Appam: 7 percent
Parshall: 3 percent

Divide: 1 percent
Tonka: 1 percent
Zahl: 1 percent

Named Component Description

Lehr

Slope: 1 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bw-6 to 11 inches; loam
Bk1-11 to 15 inches; loam
2Bk2-15 to 22 inches; gravelly loamy coarse sand
2C-22 to 60 inches; very gravelly coarse sand

Wabek

Slope: 1 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; loam
Bk-5 to 9 inches; gravelly coarse sandy loam
C-9 to 60 inches; very gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland or hayland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2187—Appam-Wabek complex, 1 to 6 percent slopes

Setting:

Appam soils are on flats. Wabek soils are on rises. These soils are on terraces of outwash plains.

Map Unit Composition (percent)

Named Components

Appam and similar soils: 45 to 65 percent
Wabek and similar soils: 15 to 30 percent

Average Component Composition

Appam: 56 percent
Wabek: 21 percent
Tally: 10 percent
Lihen: 4 percent
Lehr: 3 percent
Stady: 3 percent
Farnuf: 2 percent
Marysland: 1 percent

Named Component Description

Appam

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 6 inches; sandy loam
Bw-6 to 15 inches; sandy loam
Bk-15 to 19 inches; sandy loam
2C-19 to 60 inches; gravelly coarse sand

Wabek

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected

Typical profile:
A-0 to 5 inches; gravelly sandy loam
Bk-5 to 9 inches; gravelly coarse sandy loam
C-9 to 60 inches; very gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland or hayland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2188—Wabek-Lehr complex, 1 to 6 percent slopes

Setting:

Lehr soils are on flats. Wabek soils are on rises. These soils are on terraces on outwash plains.

Map Unit Composition (percent)

Named Components

Wabek and similar soils: 40 to 60 percent
Lehr and similar soils: 15 to 30 percent

Average Component Composition

Wabek: 50 percent
Lehr: 21 percent
Appam: 19 percent
Stady: 5 percent
Williams: 2 percent
Divide: 1 percent
Tonka: 1 percent
Zahl: 1 percent

Named Component Description

Wabek

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; gravelly sandy loam
Bk-5 to 9 inches; gravelly coarse sandy loam
C-9 to 60 inches; very gravelly coarse sand

Lehr

Slope: 1 to 6 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; loam
Bw-6 to 11 inches; loam
Bk1-11 to 15 inches; loam
2Bk2-15 to 22 inches; gravelly loamy coarse sand
2C-22 to 60 inches; very gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland or hayland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2189—Wabek-Appam complex, 6 to 35 percent slopes

Setting:

Wabek soils are on knolls and ridges. Appam soils are in swales. These soils are on terraces of outwash plains.

Map Unit Composition (percent)

Named Components

Wabek and similar soils: 45 to 65 percent

Appam and similar soils: 15 to 30 percent

Average Component Composition

Wabek: 55 percent
Appam: 25 percent
Stady: 9 percent
Lehr: 6 percent
Bowbells: 2 percent
Divide: 2 percent
Williams: 1 percent

Named Component Description

Wabek

Slope: 6 to 35 percent
Depth to Restrictive Feature: None noted
Drainage Class: Excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 5 inches; gravelly sandy loam
Bk-5 to 9 inches; gravelly coarse sandy loam
C-9 to 60 inches; very gravelly coarse sand

Appam

Slope: 6 to 25 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat excessively drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 6 inches; sandy loam
Bw-6 to 15 inches; sandy loam
Bk-15 to 19 inches; sandy loam
2C-19 to 60 inches; gravelly coarse sand

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Rangeland or hayland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2190—Williams sandy loam, 1 to 3 percent slopes

Setting:

Williams soils are on low knolls on eolian mantled till plains.

Map Unit Composition (percent)

Named Components

Williams and similar soils: 60 to 80 percent

Average Component Composition

Williams: 63 percent
Parshall: 19 percent
Farnuf: 9 percent
Niobell: 3 percent
Krem: 2 percent
Zahl: 2 percent
Hamerly: 1 percent
Tonka: 1 percent

Named Component Description

Williams

Slope: 1 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; sandy loam
Bt1-6 to 10 inches; clay loam
Bt2-10 to 15 inches; clay loam
Btk-15 to 24 inches; clay loam
Bk-24 to 36 inches; clay loam
C-36 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2191—Towner-Kratka complex, 0 to 3 percent slopes

Setting:

Towner soils are on rises. Kratka soils are in swales. These soils are on eolian mantled till plains.

Map Unit Composition (percent)

Named Components

Towner and similar soils: 40 to 65 percent
Kratka and similar soils: 15 to 35 percent

Average Component Composition

Towner: 49 percent
Kratka: 24 percent
Wyard: 13 percent
Barnes: 12 percent
Swenoda: 1 percent
Wyndmere: 1 percent

Named Component Description

Towner

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Moderately well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A1-0 to 9 inches; loamy fine sand
A2-9 to 20 inches; loamy fine sand
Bw-20 to 29 inches; loamy fine sand
2Bk-29 to 36 inches; loam
2C-36 to 60 inches; loam

Kratka

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Occasional
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; fine sandy loam
A-6 to 11 inches; fine sandy loam
Bg1-11 to 14 inches; fine sandy loam
Bg2-14 to 18 inches; loamy fine sand
Cg1-18 to 25 inches; fine sand
2Cg2-25 to 31 inches; loam
2Cg3-31 to 39 inches; loam
2Cg4-39 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2192—Kratka-Wyndmere fine sandy loams, 0 to 3 percent slopes

Setting:

Kratka soils are in swales. Wyndmere soils are on rises. These soils are on outwash plains.

Map Unit Composition (percent)

Named Components

Kratka and similar soils: 45 to 70 percent
Wyndmere and similar soils: 10 to 30 percent

Average Component Composition

Kratka: 55 percent
Wyndmere: 14 percent
Swenoda: 10 percent
Tiffany: 6 percent
Wyard: 6 percent
Buse: 3 percent
Cresbard: 3 percent
Towner: 3 percent

Named Component Description

Kratka

Slope: 0 to 1 percent
Depth to Restrictive Feature: None noted
Drainage Class: Poorly drained
Flooding: None
Water Table: Seasonal
Ponding: Occasional
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 6 inches; fine sandy loam
A-6 to 11 inches; fine sandy loam
Bg1-11 to 14 inches; fine sandy loam
Bg2-14 to 18 inches; loamy fine sand
Cg1-18 to 25 inches; fine sand
2Cg2-25 to 31 inches; loam
2Cg3-31 to 39 inches; loam
2Cg4-39 to 60 inches; clay loam

Wyndmere

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Somewhat poorly drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 8 inches; fine sandy loam
ABk-8 to 15 inches; fine sandy loam
Bk-15 to 26 inches; fine sandy loam
C-26 to 60 inches; fine sandy loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2193—Dumps, mine-Ustorthents complex, 0 to 75 percent slopes

Setting:

This soils and dumps are very steep disturbed areas resulting from the stripmining of lignite.

Map Unit Composition (percent)

Named Components

Dumps, mine and similar soils: 40 to 80 percent
Ustorthents and similar soils: 15 to 45 percent
Harriet and similar soils:
Southam and similar soils:

Average Component Composition

Dumps, mine: 60 percent
Ustorthents: 30 percent
Parnell: 4 percent
Harriet: 3 percent
Southam: 3 percent

Named Component Description

Dumps, mine

Slope: 0 to 75 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 4 to 16 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Saline within 30 inches
Sodium Affected: Sodic within 30 inches
Typical profile:
H1-0 to 4 inches; clay loam
H2-4 to 60 inches; clay loam

Ustorthents

Slope: 0 to 60 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 4 to 16 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 4 inches; loam
C-4 to 60 inches; clay loam

Figure 10. An area of Dumps, mine-Ustorthents complex, 0 to 75 percent slopes.

Management

Major uses: Wildlife habitat (fig. 10)

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2194—Haplustolls-Ustorthents complex, reclaimed, 0 to 6 percent slopes

Setting:

Haplustoll soils are on flats and in swales. Ustorthent soils are on rises. These soils are on till plains.

Map Unit Composition (percent)

Named Components

Haplustolls and similar soils: 75 to 95 percent
Ustorthents and similar soils: 5 to 20 percent

Average Component Composition

Haplustolls: 80 percent
Ustorthents: 10 percent
Williams: 4 percent
Noonan: 3 percent
Zahl: 3 percent

Named Component Description

Haplustolls

Slope: 0 to 6 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 16 to 24 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 16 inches; loam
C-16 to 60 inches; clay loam

Ustorthents

Slope: 0 to 6 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 4 to 16 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 4 inches; loam
C-4 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2195—Ustorthents-Haplustolls complex, reclaimed, 6 to 9 percent slopes

Setting:

Ustorthent soils are on shoulder slopes. Haplustoll soils are on backslopes and summits. These soils are on knolls of till plains.

Map Unit Composition (percent)

Named Components

Ustorthents and similar soils: 45 to 70 percent
Haplustolls and similar soils: 25 to 50 percent

Average Component Composition

Ustorthents: 50 percent
Haplustolls: 40 percent
Williams: 4 percent
Noonan: 3 percent
Zahl: 3 percent

Named Component Description

Ustorthents

Slope: 6 to 9 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 4 to 16 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 4 inches; loam
C-4 to 60 inches; clay loam

Haplustolls

Slope: 6 to 9 percent
Depth to Restrictive Feature: Dense material; top depth ranges from 16 to 24 inches
Drainage Class: Well drained
Flooding: None
Water Table: None
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
A-0 to 16 inches; loam
C-16 to 60 inches; clay loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section “Soil Series and Their Morphology.” Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the “Soil Properties” section.

Management

Major uses: Cropland, hayland, or pasture

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

2227—Swenoda fine sandy loam, 0 to 6 percent slopes

Setting:

Swenoda soils are on rises on eolian mantled till plains.

Map Unit Composition (percent)

Named Components

Swenoda and similar soils: 60 to 90 percent

Average Component Composition

Swenoda: 69 percent
Eckman: 10 percent
Towner: 7 percent
Arvilla: 5 percent
Kratka: 4 percent
Cresbard: 3 percent
Tonka: 2 percent

Named Component Description

Swenoda

Slope: 0 to 3 percent
Depth to Restrictive Feature: None noted
Drainage Class: Well drained
Flooding: None
Water Table: Seasonal
Ponding: None
Salt Affected: Not affected
Sodium Affected: Not affected
Typical profile:
Ap-0 to 9 inches; fine sandy loam
A-9 to 13 inches; fine sandy loam
Bw1-13 to 19 inches; fine sandy loam
Bw2-19 to 29 inches; fine sandy loam
Bw3-29 to 33 inches; fine sandy loam
2Bk-33 to 39 inches; loam
2C-39 to 60 inches; loam

Detailed soil descriptions for all map unit components are in alphabetical order in the section "Soil Series and Their Morphology." Additional information specific to this map unit, such as USDA textures, permeability, and soil reaction, is available in the "Soil Properties" section.

Management

Major uses: Cropland

For cropland limitations and hazards see Table 6. For information about managing this map unit, see the following sections: Agronomy, Rangeland, Recreation, Wildlife Habitat, Engineering, and Soil Properties.

Table 4.—Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
110	Barnes loam, 0 to 3 percent slopes	7,365	1.0
111	Barnes loam, 3 to 6 percent slopes	3,735	0.5
120	Barnes-Buse loams, 6 to 9 percent slopes	720	*
470	Cresbard-Barnes loams, 0 to 3 percent slopes	4,965	0.7
674	Farnuf loam, 0 to 3 percent slopes	5,800	0.8
676	Farnuf-Sakakawea loams, 3 to 6 percent slopes	3,410	0.5
882	Hamerly-Tonka complex, 0 to 3 percent slopes	39,080	5.4
975	Heil silt loam, 0 to 1 percent slopes	3,860	0.5
1267	Marysland loam, 0 to 1 percent slopes	1,240	0.2
1427	Parnell silty clay loam, 0 to 1 percent slopes	12,605	1.7
1439	Parshall fine sandy loam, 0 to 6 percent slopes	3,110	0.4
1466	Pits, sand and gravel	590	*
1709	Southam silt loam, 0 to 1 percent slopes	10,645	1.5
1739	Straw loam, 0 to 3 percent slopes	500	*
1835	Tonka silt loam, 0 to 1 percent slopes	19,990	2.8
1871	Vallers loam, saline, 0 to 1 percent slopes	8,250	1.1
1883	Vallers-Parnell complex, 0 to 1 percent slopes	5,340	0.7
1978	Water	10,360	1.4
2014	Williams-Bowbells loams, 0 to 3 percent slopes	13,855	1.9
2015	Williams-Bowbells loams, 3 to 6 percent slopes	6,995	1.0
2023	Williams-Niobell loams, 0 to 3 percent slopes	61,760	8.5
2024	Williams-Niobell loams, 3 to 6 percent slopes	31,380	4.3
2031	Williams-Zahl loams, 3 to 6 percent slopes	51,145	7.1
2081	Zahl-Williams loams, 9 to 15 percent slopes	59,920	8.3
2130	Williams-Zahl-Parnell complex, 0 to 9 percent slopes	6,325	0.9
2131	Zahl-Williams-Parnell complex, 0 to 35 percent slopes	69,355	9.6
2169	Harriet, Regan, and Stirum soils, 0 to 1 percent slopes	21,335	3.0
2170	Divide loam, 0 to 3 percent slopes	2,365	0.3
2171	Sakakawea-Farnuf loams, 6 to 9 percent slopes	1,215	0.2
2172	Sakakawea-Farnuf loams, 9 to 25 percent slopes	810	0.1
2173	Marias silty clay, 0 to 3 percent slopes	3,355	0.5
2174	Marias silty clay, 3 to 6 percent slopes	970	0.1
2175	Zahl-Williams loams, 6 to 9 percent slopes	56,080	7.8
2176	Zahl-Williams loams, 15 to 60 percent slopes	11,865	1.6
2177	Zahl-Williams-Vallers loams, 0 to 60 percent slopes	4,585	0.6
2178	Farnuf-Alkabo silt loams, 0 to 3 percent slopes	3,020	0.4
2179	Noonan-Niobell loams, 1 to 6 percent slopes	58,040	8.0
2180	Niobell-Noonan-Tonka complex, 0 to 3 percent slopes	26,175	3.6
2181	Miranda-Noonan loams, 0 to 3 percent slopes	34,225	4.7
2182	Portal-Lihen fine sandy loams, 0 to 3 percent slopes	3,870	0.5
2183	Lihen-Blanchard loamy fine sands, 1 to 6 percent slopes	1,915	0.3
2184	Williams-Zahl complex, 3 to 6 percent slopes	10,745	1.5
2185	Williams-Zahl-Lihen complex, 6 to 15 percent slopes	2,010	0.3
2186	Lehr-Wabek loams, 1 to 3 percent slopes	7,325	1.0
2187	Appam-Wabek complex, 1 to 6 percent slopes	3,875	0.5
2188	Wabek-Lehr complex, 1 to 6 percent slopes	3,635	0.5
2189	Wabek-Appam complex, 6 to 35 percent slopes	10,015	1.4
2190	Williams sandy loam, 1 to 3 percent slopes	2,510	0.3
2191	Towner-Kratka complex, 0 to 3 percent slopes	1,390	0.2
2192	Kratka-Wyndmere fine sandy loams, 0 to 3 percent slopes	1,520	0.2
2193	Dumps, mine-Ustorthents complex, 0 to 75 percent slopes	3,485	0.5
2194	Haplustolls-Ustorthents complex, reclaimed, 0 to 6 percent slopes	570	*
2195	Ustorthents-Haplustolls complex, reclaimed, 6 to 9 percent slopes	350	*
2227	Swenoda fine sandy loam, 0 to 6 percent slopes	3,145	0.4
	Total	722,700	100.0

* Less than 0.1 percent.

Formation and Classification of the Soils

This section relates the soils in the survey area to the major factors of soil formation and describes the system of soil classification.

Formation of the Soils

Soil forms through processes acting on deposited or accumulated geologic material. Characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life on and in the soil; (4) the topography, or lay of the land; and (5) the length of time that forces of soil formation have acted on the soil material (Buol et al. 1980).

Climate and plant and animal life, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of geological deposits and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are influenced by relief. Finally, time is needed for changing the parent material into soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent Material

Parent material is the unconsolidated mass in which soil forms. It determines the chemical and mineral composition of the soil. Most of the soils of Burke County formed in glacial drift. The advancing glacier picked up rocks and soil, ground and mixed them, and deposited the material as the glacier receded. Unsorted material deposited by the glacier is called glacial till. The till in the southern portion of the county is mostly loam, highly calcareous, with medium bulk density and low salt content. The soils that formed in this till range from well to weakly developed, depending on degree of slope. The well-developed soils, such as Williams, formed in the less sloping areas. On steeper areas, less developed soils such as Zahl, formed. Till in the northern portion of the county has a high salt content and high bulk density. Soils that formed in this till are well developed but have a salt content that affects crop production. Noonan and Niobell are examples of these soils. Other soils such as Marias and Sakakawea formed in glaciolacustrine deposits, or material deposited by water in glacial lakes. They usually have higher clay and silt content than the glacial till. Other soils formed from glaciofluvial deposits or material deposited by glacial meltwater. Some of these soils, such as Lihen and Blanchard, formed in deposits of mostly sand. Others, such as Wabek and Appam, formed in deposits containing significant amounts of gravel. Local glaciofluvial deposits are the source of sandy eolian material, most of which occurs as a thin mantle over other kinds of material. Swenoda and Towner soils formed in thin eolian deposits over glacial till. Local alluvium is the parent material for soils such as Parnell and Tonka, which are located in closed depressions. Some soils, such as Straw formed in alluvial from local rivers and streams. Other soils, such as Harriet, formed in alluvium that commonly has a high content of sodium and /or other salts.

Some sedimentary bedrock also outcrops in the county. Most areas of bedrock outcrop have been mined for their lignite content. These sedimentary rocks are part of the Sentinel Butte and Tongue River formations of the Fort Union Group. They are composed of interbedded sandstone, shale, and lignite, with various amounts of salts. These mined areas have been mapped Dumps,mine, Ustorthents, or Haplustolls.

Although the parent materials are of common origin, their properties vary greatly, sometimes within small areas, depending on how the materials were deposited.

Glacial drift covers most of Burke County. The surficial glacial drift was deposited during the Wisconsin-aged glaciation. Most of the southern portion of the county is included in the very hilly

Missouri Coteau. The Coteau has glacial deposits over 100 feet thick (Freers, 1973). Glacial landforms include ground moraines, end moraines, dead-ice moraines, collapsed outwash, ice-walled lake plains, collapsed lake sediments, and disintegration ridges and trenches. Proglacial landforms include meltwater channels and outwash plains. The drainage on the Missouri Coteau is nonintegrated with numerous small lakes and undrained intermittent ponds. Sedimentary bedrock of Tertiary age is found beneath the glacial drift. Additional information related to the surface geology of northwestern North Dakota can be found in publications by Bluemle (1975,1991), Clayton and Freers (1967), Howard (1960), and Murphy (1996).

Most of the water for domestic and livestock needs in Burke County is obtained from ground water sources. The most important aquifers are found in glacial drift of Quaternary age and the sedimentary bedrock from the Sentinel Butte and Tongue River Formations of Tertiary age. The aquifers with the greatest potential for development are the sand and gravel deposits that form the Columbus aquifer. The more permeable parts of these aquifers will yield about 200 gallons per minute. This aquifer is a buried glacial diversion channel of the ancestral Yellowstone River and occurs in the northern portion of the county. Yields of 10 to 350 gallons per minute are possible from other outwash, glaciofluvial, and valley-fill deposits that are scattered throughout the county. Yields from aquifers in the Sentinel Butte and Tongue River formations generally are only a few gallons per minute, but may be as great as 100 gallons per minute (Armstrong, 1971).

Water from the glacial-drift aquifers differs greatly in chemical quality (Armstrong, 1971). Water low in dissolved solids generally is hard and contains abundant calcium bicarbonate. Water high in dissolved solids generally is also hard and contains abundant sodium sulfate. The Sentinel Butte Formation and Tongue River Formation generally yield water of a sodium bicarbonate type, but sulfate concentrations are also high. Many aquifers are usually too saline to be recommended for human consumption.

Several processes have been involved in the formation of soils in Burke County. These processes are accumulation of organic matter; solution, transfer, and removal of calcium carbonates and bases; and liberation and translocation of silicate clay minerals. In most soils, more than one of these processes has been active in horizon differentiation.

The parent materials in which most of the soils developed initially contained generous amounts of calcium and magnesium carbonate minerals. These minerals have been dissolved by water and removed from the upper horizons of the soil profile. Pure water is not an effective agent for dissolving calcium and magnesium carbonates. These minerals are only slightly soluble in pure water, but become moderately soluble and dissolve much more rapidly in a weak acid. The respiratory activity of plants is a significant factor in dissolving calcium and magnesium carbonates. As plants respire, they give off carbon dioxide. Carbon dioxide dissolves in water to form a weak carbonic acid solution. This facilitates dissolving calcium and magnesium carbonates in the soil.

In a dissolved state, calcium and magnesium are in the form of ions that have a positive net electrical charge. Calcium and magnesium ions are essential elements in plant nutrition, and can either be taken up by plant roots or carried away (leached) with moving soil water. Some of the calcium and magnesium ions are leached from the soil profiles. “Seep” sites along steep slopes that have deposits of recently precipitated calcium and magnesium carbonates provide evidence of leaching.

A large number of the calcium and magnesium ions that dissolved from carbonate mineral ions are translocated to upper soil horizons by a cyclical process of root uptake and ultimate release when plant material decomposes. As vegetation decays, positively charged calcium and magnesium ions move downward with water to the upper horizons of soil profiles. There they are held by the electrostatic forces of negatively charged clay particles and are again available for plant uptake.

Climate

Climate has direct and indirect effects on the formation of soils. Precipitation, temperature, and wind directly affect the weathering and reworking of soil material. The climate indirectly affects soil formation through its effects on the amount and kind of vegetation and animal life on or in the soil.

In addition to weathering soil material, precipitation and temperature affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil. Freezing and thawing help break down soil particles in the parent material, thereby providing surface area for chemical processes. Cool temperatures affect the content of organic matter by slowing the decay of plant material and animal remains.

Burke County has a continental, semi-arid climate characterized by long, cold winters and short, warm summers. The soil is generally frozen to a depth of 3 to

6 feet from November to April. During this time, except for some effects of frost action, the soil forming processes are mostly dormant. Most of the precipitation falls during the growing season and is distributed in an erratic pattern. It is during this part of the year that soil-forming processes influenced by climate are most active. The climate is fairly uniform throughout the county with slightly increased average precipitation rates in the eastern part.

Living Organisms

Soils in Burke County formed mainly under grassland vegetation. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. Fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result of these changes in the soil, less water runs off the surface and more moisture is available for increased microbiological activity. Decay of plants improves the available water capacity, tilth, and fertility of the soil. Decayed organic matter, accumulating over long periods, gives the surface layer its dark color.

On somewhat poorly drained and moderately well drained, nearly level soils, such as Bowbells, Hamerly, and Swenoda the native vegetation is mainly tall and medium-sized grasses. Principal grasses are big bluestem, switchgrass, indiangrass, and little bluestem.

On well drained and excessively drained, nearly level to steep soils, such as Wabek, Williams, and Zahl, short and medium-sized grasses are dominant. Among these grasses are green needlegrass, western wheatgrass, little bluestem, sideoats grama, plains muhly, and blue grama.

On the poorly drained and very poorly drained, depressional soils such as Parnell and Tonka, the vegetation consists of tall grasses, reeds, rivergrass, slough sedge, American mannagrass, northern reedgrass, and prairie cordgrass.

Micro-organisms have important effects on soil formation because they feed on undecomposed organic matter and convert it into humus from which plants can obtain nutrients for growth. Bacteria and different kinds of fungi attack leaves and other forms of organic matter. Insects, earthworms, and small burrowing animals help mix the humus with the soil.

Human activities greatly affect soil formation. Management measures can alter soil drainage. They can help to control erosion, thus maintaining fertility. Poor management can increase the susceptibility to erosion and thus result in an unproductive soil.

Topography

The topography of Burke County can be divided into four geographic areas: a) Central Lowlands; b) Missouri Coteau Escarpment; c) Missouri Coteau; and d) Missouri Slope (Freers, 1973). The Central Lowlands are a gently undulating glaciated plain with low relief found in the northern portion of the county. Water flows from most areas into natural drainageways, but many shallow depressions retain water after heavy rains and spring thaw. Many knobs and ridges are scattered throughout the area. Most of the stream valleys, such as the East Branch of Short Creek, which dissect the area are shallow. The Des Lacs valley, however, is deep. The Missouri Coteau Escarpment lies immediately south of the Central Lowlands. In this area, the land surface elevation rises from about 2,000 feet to about 2,350 feet above sea level in about 3.5 miles. The escarpment is a gently sloping smooth surface that is crossed by many steep-sided valleys. Drainage is integrated on the Missouri Coteau Escarpment and flows toward the Central Lowlands. The Missouri Coteau is a hilly area with moderate to high relief and steep slopes. Hundreds of depressions are present with adjacent hills as much as 150 feet above the depressions. Toward the southern edge of the Missouri Coteau, the relief becomes less and the slopes gentler. Little or no integration of drainage occurs on the Missouri Coteau except along streams such as Stony Creek and larger lakes, such as Upper Lostwood Lake. Rainfall collects in sloughs and depressions throughout the area. The Coteau region of North Dakota is often referred to as the Prairie Pothole region. The Missouri Coteau also serves as a continental divide, separating the Hudson Bay and Gulf of Mexico watersheds. The Missouri Slope in southwestern Burke County is an area of low to moderate relief with gentle to moderate slopes. Streams in this area drain into the Missouri River system.

Topography influences the formation of soil through its effect on drainage, runoff, and erosion. Many differences in the soils of this county result from their topographic position. Among these differences are drainage, thickness of the A horizon, content of organic matter, color, features of the subsoil, thickness of the solum, and degree of horizon differentiation.

Runoff is rapid on steep slopes, and only a small percentage of the rainfall penetrates the soil. Under these conditions, there is little moisture for plant growth and soil development. The soils on steeper slopes are thin and low in organic matter content. They

have weak horizonation. Examples are the Wabek and Zahl soils.

Soils on nearly level to rolling slopes are moderately well drained and well drained. Moisture is sufficient to support good stands of mixed native grasses, and the soils have well developed profiles characterized by a black to very dark gray A horizon and a brown to very dark brown B horizon. Examples are the Farnuf and Williams soils. Most of the moderately well drained soils occur on level or slightly concave areas. They generally have a thicker A horizon, a darker colored B horizon, and a greater depth to lime than those on convex, undulating, or rolling landscapes. An example is the Bowbells soils.

Depressional areas that receive large amounts of runoff from higher elevations have somewhat poor to very poor natural drainage. Soils formed in depressions vary widely in profile development, depending on the degree of wetness. Tonka soils, which are in shallow depressions, exhibit an advanced degree of horizonation because of alternate wet and dry cycles that occur in these depressions. These soils have properties much like soils from areas of much higher precipitation. They are examples of soils in which translocated clays have accumulated in the Bt horizon. Gleying, or the reduction and transfer of iron, has occurred to some degree in all of the very poorly to somewhat poorly drained soils in the county. In these naturally wet soils, this process has had a significant influence on horizon differentiation. The gray color and redoximorphic features of the subsoil indicate the redistribution of reduced iron oxides. Southam soils, which are in deep depressions, are nearly continuously wet and have a thick surface layer and carbonates throughout. Horizonation in these soils is minimal and mostly the result of sedimentary rather than soil forming processes.

Topography in Burke County is also influenced by water that melted from the glacier and resulted in deposition of sand and gravel. Soils in these areas include Appam and Wabek. Sand and gravel pits may be established in these areas. The materials are used mainly for surfacing secondary roads and as a base for paved highways. The sand and gravel may be of low quality and onsite investigation is recommended to determine the suitability of the deposits. Excess silt or clay and a high shale content are common limitations for the use of these deposits.

Time

The formation of soil is a very slow process. Much time is required for the processes of soil formation to act on the parent material and to form distinct horizons within the soil profile. Approximately 12,000 years have passed since the glacier receded from Burke County (Freers, 1973). In geological terms, the soils in the county are young.

More time has been available for the formation of Williams soils on glacial till plains than for the formation of Straw soils on flood plains. The forces of soil formation have been continually acting on the parent material of the Williams soils; however, Straw soils are continually gaining new parent material at the surface as a result of flooding. Williams soils have well defined horizons whereas Straw soils have less distinct horizons.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (Soil Survey Staff, 1999). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 5, “Classification of the Soils” shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Twelve soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in sol. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (Ust, meaning burnt, plus oll, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Argiustoll (Argi, meaning clay increase in the subsoil, plus ustoll, the suborder of the Mollisols that has a ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive.

Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the group of soils that meets the central concept of that subgroup. An example is Typic Argiustolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, cation exchange activity, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed superactive, frigid Typic Argiustolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Williams soil series.

Table 5.—Classification of the Soils

(An asterisk in the first column indicates a taxadjunct to the series. See text for a description of those characteristics that are outside the range of the series.)

Soil name	Family or higher taxonomic class
*Aberdeen	Fine, smectitic, frigid Glossic Natrudolls
Alkabo	Fine-silty, mixed, superactive, frigid Glossic Natrustolls
Appam	Sandy, mixed, frigid Typic Haplustolls
Arnegard	Fine-loamy, mixed, superactive, frigid Pachic Haplustolls
Arvilla	Sandy, mixed, frigid Calcic Hapludolls
Barnes	Fine-loamy, mixed, superactive, frigid Calcic Hapludolls
Belfield	Fine, smectitic, frigid Glossic Natrustolls
Blanchard	Mixed, frigid Typic Ustipsamments
Bowbells	Fine-loamy, mixed, superactive, frigid Pachic Argiustolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Pachic Haplustolls
Bryant	Fine-silty, mixed, superactive, frigid Typic Haplustolls
Buse	Fine-loamy, mixed, superactive, frigid Typic Calciudolls
Cavour	Fine, smectitic, frigid Calcic Natrudolls
Colvin	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Cresbard	Fine, smectitic, frigid Glossic Natrudolls
Divide	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls
Dooley	Fine-loamy, mixed, superactive, frigid Typic Argiustolls
Easby	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Eckman	Coarse-silty, mixed, superactive, frigid Calcic Hapludolls
*Exline	Fine, smectitic, frigid Leptic Natrudolls
Farnuf	Fine-loamy, mixed, superactive, frigid Typic Argiustolls
Grano	Fine, smectitic, frigid Typic Endoaquerts
Hamerly	Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls
Hamlet	Fine-loamy, mixed, superactive, frigid Oxyaquic Hapludolls
Haplustolls	Haplustolls
Harriet	Fine, smectitic, frigid Typic Natraquolls
Hegne	Fine, smectitic, frigid Typic Calciaquerts
Heil	Fine, smectitic, frigid Typic Natraquerts
Korchea	Fine-loamy, mixed, superactive, calcareous, frigid Mollic Ustifluvents
Kratka	Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls
Krem	Fine-loamy, mixed, superactive, frigid Typic Paleustolls
Lehr	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Haplustolls
Letcher	Coarse-loamy, mixed, superactive, frigid Calcic Natrudolls
Lihen	Sandy, mixed, frigid Entic Haplustolls
Maddock	Sandy, mixed, frigid Entic Hapludolls
Makoti	Fine-silty, mixed, superactive, frigid Pachic Haplustolls
Marias	Fine, smectitic, frigid Chromic Haplusterts
Marysland	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls
McDonaldsville	Clayey over sandy or sandy-skeletal, smectitic, frigid Vertic Endoaquolls
Minnewaukan	Mixed, frigid Typic Psammaquents
Miranda	Fine, smectitic, frigid Leptic Natrustolls
Niobell	Fine, smectitic, frigid Glossic Natrustolls
Noonan	Fine, smectitic, frigid Typic Natrustolls
Parnell	Fine, smectitic, frigid Vertic Argiaquolls
Parshall	Coarse-loamy, mixed, superactive, frigid Pachic Haplustolls
Portal	Coarse-loamy, mixed, superactive, frigid Typic Natrustolls
Reeder	Fine-loamy, mixed, superactive, frigid Typic Argiustolls
Regan	Fine-silty, mixed, superactive, frigid Typic Calciaquolls
Roseglen	Fine-loamy, mixed, superactive, frigid Pachic Haplustolls
Sakakawea	Coarse-silty, mixed, superactive, frigid Typic Calciustolls
Seroco	Mixed, frigid Typic Ustipsamments
Southam	Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls
Stady	Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Haplustolls
Stirum	Coarse-loamy, mixed, superactive, frigid Typic Natraquolls
Straw	Fine-loamy, mixed, superactive, frigid Cumulic Haplustolls
Svea	Fine-loamy, mixed, superactive, frigid Pachic Hapludolls

Table 5.—Classification of the Soils--Continued

Soil name	Family or higher taxonomic class
Swenoda	Coarse-loamy, mixed, superactive, frigid Pachic Hapludolls
Tally	Coarse-loamy, mixed, superactive, frigid Typic Haplustolls
Tiffany	Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls
Tonka	Fine, smectitic, frigid Argiaquic Argialbolls
Towner	Sandy over loamy, mixed, superactive, frigid Calcic Hapludolls
Trembles	Coarse-loamy, mixed, superactive, calcareous, frigid Typic Ustifluvents
Ustorthents	Ustorthents
Vallers	Fine-loamy, mixed, superactive, frigid Typic Calciaquolls
Velva	Coarse-loamy, mixed, superactive, frigid Fluventic Haplustolls
Wabek	Sandy-skeletal, mixed, frigid Entic Haplustolls
Wildrose	Fine, smectitic, frigid Typic Haplusterts
Williams	Fine-loamy, mixed, superactive, frigid Typic Argiustolls
Wyard	Fine-loamy, mixed, frigid Typic Epiaquolls
Wyndmere	Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls
Wyrene	Sandy, mixed, frigid Aeric Calciaquolls
Zahl	Fine-loamy, mixed, superactive, frigid Typic Calciustolls

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetical order. Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (Soil Survey Staff, 1993). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (USDA-NRCS, 1999). Effervescence refers to disseminated lime throughout the horizon. Following the pedon description is the range of important characteristics of the soil series.

Aberdeen Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 2 percent
Notes: These soils are sodic. These soils are drier than is definitive of the Aberdeen series. This difference, however, does not alter the usefulness or behavior of the soils.

Taxonomic class: Fine, smectitic, frigid Glossic Natrudolls

Typical pedon:
Aberdeen silty clay loam, 580 feet west and 93 feet south of the northeast corner of sec. 9, T. 122 N., R. 63 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

BE—8 to 11 inches; very dark gray (10YR 3/1) silty clay loam, gray (10YR 5/1) dry; gray (10YR 6/1) dry silt coatings on faces of peds; weak medium subangular blocky structure parting to weak thin platy; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Btn1—11 to 18 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate fine blocky; hard, firm, sticky and plastic; shiny films on faces of peds; neutral; clear wavy boundary.

Btn2—18 to 26 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to moderate medium and fine blocky; hard, firm, sticky and plastic; shiny films on faces of peds; neutral; clear wavy boundary.

Bkz1—26 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam, light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common fine nests of gypsum and other salts; common very fine accumulations of lime; strong effervescence; slightly alkaline; clear wavy boundary.

Bkz2—31 to 38 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, firm, sticky and plastic; common fine nests of gypsum and other salts; common very fine accumulations of lime; strong effervescence; slightly alkaline; gradual wavy boundary.

C1—38 to 51 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations and few fine distinct gray (10YR 5/1) redoximorphic depletions; massive; hard, friable, slightly sticky and slightly plastic; few fine threads and nests of gypsum and other salts; slight effervescence; slightly alkaline; gradual wavy boundary.

C2—51 to 60 inches; light olive brown (2.5Y 5/4) silt loam, laminated with thin layers of silty clay and very fine sandy loam, pale yellow (2.5Y 7/4) dry; common fine prominent yellowish brown (10YR 5/6) and strong brown (7.5YR 5/6) redoximorphic concentrations and gray (10YR 5/1) redoximorphic depletions; massive; laminations 1 to 3 mm thick; slightly hard, friable, slightly sticky and slightly plastic; slight effervescence; slightly alkaline.

Range in Characteristics

Depth to lime: 16 to 40 inches
Notes: Some pedons have an E or B/E horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry
Texture: silty clay loam or silt loam

BE horizon:
Value: 3 or 4, 4 or 5 dry
Chroma: 1 or 2

Btn horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3
Texture: silty clay, silty clay loam, or clay

Bkz horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4
Texture: silty clay loam, silty clay, or silt loam

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 8 dry
Texture: silt loam or silty clay loam

Alkabo Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent
Notes: These soils are sodic.

Taxonomic class: Fine-silty, mixed, superactive, frigid Glossic Natrustolls

Typical pedon:
Alkabo silt loam, 2,100 feet east and 300 feet north of the southwest corner of sec. 6, T. 163 N., R. 9 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

B/E—6 to 9 inches; dark brown (10YR 4/3) (B) and brown (10YR 5/3) (E) silt loam, very dark grayish brown (10YR 3/2) (B) and dark grayish brown (10YR 4/2) (E) moist; moderate medium prismatic structure parting to strong medium angular blocky; hard, firm, slightly sticky and slightly plastic; common faint clay films on faces of peds; slightly acid; clear smooth boundary.

Btn1—9 to 13 inches; yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; strong medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; many prominent clay films on faces of peds; few clean sand grains on faces of peds; neutral; clear wavy boundary.

Btn2—13 to 17 inches; light olive brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; hard, firm, sticky and plastic; many prominent clay films on faces of peds; neutral; clear wavy boundary.

Bk1—17 to 27 inches; light olive brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium angular blocky; slightly hard, friable, sticky and plastic; common fine and medium irregularly shaped masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—27 to 45 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, sticky and plastic; common medium and few coarse irregularly shaped masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

2C—45 to 60 inches; olive (5Y 5/3) clay loam, olive (5Y 4/3) moist; massive; hard, firm, very sticky and very plastic; about 10 percent gravel; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 18 inches

Depth to lime: 15 to 30 inches
Percent rock fragments: 0 to 2 percent above the 2C horizon and 2 to 10 percent in the 2C horizon
Depth to glacial till: 40 to more than 60 inches
Notes: A thin lag line ranging up to 6 inches thick and containing up to 30 percent rock fragments is at the top of the 2C horizon in some pedons. Some pedons have a By, Byz, 2Bk, or C horizon.

A horizon:
Value: 3 or 4, 2 or 3 moist

B/E horizon:
Hue: 10YR or 2.5Y
Chroma: 2 or 3
Texture: loam or silt loam

Btn horizon:
Value: 4 to 6, 3 to 5 moist
Chroma: 2 to 4
Texture: silt loam or silty clay loam

Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6 moist
Texture: loam or silty clay loam

2C horizon:
Hue: 2.5Y or 5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 4
Texture: loam or clay loam

Appam Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part and very rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 6 percent

Taxonomic class: Sandy, mixed, frigid Typic Haplustolls

Typical pedon:
Appam sandy loam, 2,600 feet north and 700 feet east of the southwest corner, sec. 36, T. 160 N., R. 93 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 6 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and nonplastic; common fine and very fine roots; about 3 percent gravel; neutral; clear boundary.

Bw—6 to 15 inches; very dark grayish brown (10YR 3/2) sandy loam, brown (10YR 4/3) dry; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; very dark brown (10YR 2/2) dry organic stains on faces of peds; about 5 percent gravel; neutral; clear wavy boundary.

Bk—15 to 19 inches; brown (10YR 5/3) sandy loam, very pale brown (10YR 7/3) dry; weak medium and coarse prismatic structure parting to weak medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; about 12 percent gravel; many coarse irregularly shaped masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

2C—19 to 60 inches; yellowish brown (10YR 5/4) gravelly coarse sand, light yellowish brown (10YR 6/4) dry; single grain; loose, nonsticky and nonplastic; about 30 percent gravel: strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches
Depth to lime: 12 to 30 inches
Depth to sand and gravel: 14 to 25 inches

A horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 2 or 3

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 or 4, 4 to 6 dry
Chroma: 2 to 4
Texture: sandy loam or coarse sandy loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 8 dry
Chroma: 2 or 3
Texture: sandy loam or coarse sandy loam

2C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 7 dry
Chroma: 2 to 4

Texture: sand, loamy sand, or coarse sand
Notes: Contains 5 to 35 percent gravel.

Arnegard Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Terraces, till plains, and uplands
Parent material: Alluvium
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Pachic Haplustolls

Typical pedon:
Arnegard loam, 1,575 feet north and 1,700 feet west of the southeast corner, sec. 35, T. 132 N., R. 93 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and many very fine roots; neutral; clear smooth boundary.

A—6 to 13 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; neutral; gradual wavy boundary.

Bw1—13 to 27 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; many very fine roots; neutral; clear wavy boundary.

Bw2—27 to 36 inches; very dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; slightly alkaline; clear wavy boundary.

Bk—36 to 60 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine irregular masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to more than 30 inches
Depth to lime: 20 to more than 60 inches
Notes: Some pedons have a BCk or C horizon.

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4 , 3 to 5 dry
Texture: loam, silt loam, or clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 5 to 7 dry
Chroma: 2 to 4
Notes: Some pedons do not have a Bk horizon.

Arvilla Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part and rapid or very rapid in the lower part
Landform: Outwash plains and till plains
Parent material: Glacial outwash
Slope: 0 to 6 percent

Taxonomic class: Sandy, mixed, frigid Calcic Hapludolls

Typical pedon:
Arvilla sandy loam, 1,850 feet south and 1,320 feet east of the northwest corner of sec 6, T. 161 N., R. 72 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 5 inches; black (10YR 2/1), broken face, sandy loam, very dark gray (10YR 3/1), broken face, dry; weak medium and fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; 5 percent mixed gravel; neutral; clear smooth boundary.

A—5 to 10 inches; black (10YR 2/1), broken face, sandy loam, very dark gray (10YR 3/1), broken face, dry; moderate medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout;

5 percent mixed gravel; neutral; gradual wavy boundary.

Bw—10 to 16 inches; brown (10YR 4/3), broken face, sandy loam, brown (10YR 5/3) dry; weak medium prismatic structure parting to moderate medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine roots throughout; 5 percent mixed gravel; neutral; abrupt smooth boundary.

2Bk—16 to 31 inches; brown (10YR 4/3) gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; few very fine roots throughout; masses of lime located on undersides of pebbles; strong effervescence throughout (HCl, unspecified); 30 percent mixed gravel; slightly alkaline; gradual wavy boundary.

2C—31 to 60 inches; brown (10YR 4/3) gravelly coarse sand, pale brown (10YR 6/3) dry; single grain; loose, nonsticky and nonplastic; slight effervescence throughout (HCl, unspecified); 30 percent mixed gravel; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Depth to lime: 13 to 25 inches
Depth to sand and gravel: 14 to 25 inches
Notes: Some pedons have a loamy sand or sandy loam Bk horizon.

Bw horizon:
Notes: 0 to 10 percent gravel

2Bk and 2C horizons:
Notes: They have more than 5 percent gravel and average 20 to 35 percent gravel.

Barnes Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Glacial till
Slope: 1 to 25 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Calcic Hapludolls

Typical pedon:
Barnes loam, 2,100 feet west and 1,450 feet north of the southeast corner of sec. 27, T. 158 N., R. 69 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine pores; slightly alkaline; abrupt smooth boundary.

Bw1—7 to 11 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; moderate medium prismatic structure parting to moderate medium angular blocky; slightly hard, firm, slightly sticky and slightly plastic; common medium pores; patches of clay on vertical faces of peds; slightly alkaline; clear wavy boundary.

Bw2—11 to 19 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common medium pores; slightly alkaline; clear wavy boundary

Bk—19 to 37 inches; olive brown (2.5Y 4/4) loam, pale yellow (2.5Y 7/4) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; friable, slightly sticky and slightly plastic; few medium pores; few masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—37 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; hard, firm, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Notes: Some pedons have a BCk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 to 5, 3 to 6 dry
Chroma: 2 to 4

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

C horizon:
Notes: Some pedons do not have a C horizon.

Belfield Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Terraces and uplands
Parent material: Alluvium
Slope: 0 to 3 percent
Notes: These soils are sodic. Some pedons have a Bky or BCky horizon.

Taxonomic class: Fine, smectitic, frigid Glossic Natrustolls

Typical pedon:
Belfield silty clay loam, 2,320 feet east and 235 feet north of the southwest corner, sec. 36, T. 137 N., R. 98 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 9 inches; very dark grayish brown (10YR 3/2) silty clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate very fine subangular blocky; very hard, friable; many roots; many very fine pores; common uncoated sand grains on faces of peds; slightly acid; clear wavy boundary.

E/B—9 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; moderate medium prismatic structure parting to weak medium platy which parts to strong very fine subangular blocky; very hard, friable; many roots; many very fine pores; thin light gray (10YR 7/1) dry uncoated sand grains on top of plates and discontinuous on bottom of plates; slightly acid; clear smooth boundary.

Btn1—12 to 17 inches; very dark grayish brown (2.5Y 3/2) silty clay, grayish brown (2.5Y 5/2) dry; strong medium prismatic structure parting to strong medium and fine angular blocky; extremely hard, friable; common roots; many very fine pores; faint continuous clay films on faces of peds; common uncoated sand grains in the upper part and few in the lower part; neutral; clear wavy boundary.

Btn2—17 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light olive brown (2.5Y 5/4) dry; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; very hard, friable; few roots; many fine pores; faint clay films of olive brown (2.5Y 4/3); slightly alkaline; clear wavy boundary.

Bk1—24 to 31 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to weak medium subangular blocky; very hard, friable; few roots; many fine and very fine pores; common threads and masses of lime; strong effervescence; moderately alkaline; clear wavy boundary.

Bk2—31 to 43 inches; dark grayish brown (2.5Y 4/2) and light brownish gray (2.5Y 6/2) silty clay loam, light brownish gray (2.5Y 6/2) and white (2.5Y 8/2) dry; weak medium prismatic structure parting to moderate medium subangular blocky; very hard, friable; many fine pores; many threads and masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—43 to 60 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; massive; very hard, friable; many fine pores; violent effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 25 inches
Depth to lime: 22 to 55 inches
Notes: Some pedons have a BC horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 2 or 3

E/B horizon:
Notes: Some cultivated pedons do not have an E/B horizon.

Btn horizon:
Hue: 10YR or 2.5Y
Value: 2 to 5, 4 to 6 dry
Texture: clay loam, silty clay, or silty clay loam

C horizon:
Value: 4 or 5, 5 to 7 dry
Texture: loam, clay loam, or silty clay loam

Blanchard Series

Depth Class: Very deep
Drainage Class: Excessively drained
Permeability: Rapid
Landform: Uplands
Parent material: Eolian
Slope: 6 to 15 percent

Taxonomic class: Mixed, frigid Typic Ustipsamments

Typical pedon:
Blanchard fine sand, 1,320 feet east and 1,320 feet north of the southwest corner, sec. 26, T. 31 N., R. 57 E. (Colors are for dry soil unless otherwise stated.)

A—0 to 3 inches; grayish-brown (10YR 5/2) fine sand, very dark grayish brown (10YR 3/2) moist; single grain; loose, nonsticky and nonplastic; many fine roots; slightly alkaline (pH 7.4); clear boundary.

C—3 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose; nonsticky and nonplastic; many fine roots in upper part, few very fine roots in lower part; many very fine pores; slight effervescence; slightly alkaline (pH 7.6).

Range in Characteristics

Depth to lime: 0 to 17 inches

A horizon:
Hue: 2.5Y or 10YR
Value: 4 to 6, 2 to 4 moist
Texture: fine sand or loamy fine sand

C horizon:
Hue: 2.5Y or 10YR
Chroma: 2 to 4
Texture: fine sand or loamy sand

Bowbells Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till and alluvium
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Pachic Argiustolls

Typical pedon:
Bowbells loam, 2,040 feet south and 365 feet west of the northeast corner, sec. 32, T. 151 N., R. 85 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 6 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic and moderate medium subangular blocky structure parting to strong fine granular; slightly hard, friable; many roots; many fine pores; neutral; clear wavy boundary.

Bt1—6 to 14 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard, friable; common fine roots; many fine pores; faint very dark brown (10YR 2/2) clay films on faces of peds; neutral; gradual wavy boundary.

Bt2—14 to 23 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate medium angular blocky; hard, friable; common fine roots; common fine pores; faint clay films on faces of prisms and blocks; neutral; clear wavy boundary.

Bk—23 to 36 inches; light olive brown (2.5Y 5/4) loam, pale yellow (2.5Y 7/4) dry; weak medium and fine subangular blocky structure; hard, friable; few fine roots; common fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; massive but fractures into weak laminar and fine subangular blocks characteristic of till; hard, firm; few fine masses of lime; few stones; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to more than 30 inches
Notes: Some pedons have a BCk horizon.

A horizon:
Value: 2 or 3, 3 or 4 dry
Chroma: 2 or 3

Bt horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5, 5 to 7 dry
Texture: loam or clay loam

C horizon:
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Bowdle Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the upper part and rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Pachic Haplustolls

Typical pedon:
Bowdle loam, 265 feet east and 230 feet south of northwest corner, sec. 7, T. 122 N., R. 73 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate fine and medium granular structure; soft, friable, slightly plastic; neutral; abrupt smooth boundary.

Bw1—8 to 16 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear smooth boundary.

Bw2—16 to 22 inches; very dark brown (10YR 2/2) crushing to very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few pebbles coated with lime; neutral; abrupt wavy boundary.

Bk—22 to 25 inches; very dark grayish brown (2.5Y 3/2) crushing to dark grayish brown (2.5Y 4/2) gravelly loam, grayish brown (2.5Y 5/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; common fine accumulations of lime; strong effervescence; slightly alkaline; abrupt wavy boundary.

2C1—25 to 30 inches; varicolored, very gravelly loamy sand; common fine fragments of shale; strong effervescence; slightly alkaline; clear smooth boundary.

2C2—30 to 60 inches; varicolored, very gravelly loamy sand; common fine fragments of shale; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to more than 28 inches
Depth to lime: 14 to 32 inches
Depth to sand and gravel: 20 to 40 inches
Notes: Some pedons do not have a Bk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Chroma: 2 to 4
Texture: loam or clay loam

2C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: sand or loamy sand
Notes: It has 5 to 40 percent gravel, but averages more than 15 percent above a depth of 40 inches.

Bryant Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 6 percent

Taxonomic class: Fine-silty, mixed, superactive Typic Haplustolls

Typical pedon:
Bryant loam, 2,360 feet east and 215 feet north of the southwest corner of sec. 21, T. 123 N., R. 71 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky and moderate fine and medium granular structure; slightly hard, very friable; neutral; abrupt smooth boundary.

Bw—8 to 15 inches; very dark grayish brown (10YR 3/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few rock fragments; neutral; abrupt wavy boundary.

Bk1—15 to 19 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure; soft, friable, slightly sticky and slightly plastic; few rock fragments; common medium accumulations of lime; strong effervescence (17 percent calcium carbonate); moderately alkaline; clear smooth boundary.

Bk2—19 to 32 inches; olive brown (2.5Y 4/4) loam, light brownish gray (2.5Y 6/2) dry; massive; soft, friable; few rock fragments; common coarse accumulations of lime; violent effervescence (24 percent calcium carbonate); moderately alkaline; clear smooth boundary.

C—32 to 60 inches; dark brown (10YR 4/3) loam, yellowish brown (10YR 5/4) dry; many medium prominent reddish yellow (7.5YR 7/8) dry redoximorphic concentrations and light gray (10YR 7/1) dry redoximorphic depletions; massive; soft, friable; few rock fragments; strong effervescence (14 percent calcium carbonate); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

Ap horizon:
Value: 2 or 3, 4 or 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 3 or 4, 4 to 6 dry
Chroma: 2 to 4
Texture: loam, silt loam, or clay loam

Bk horizon:
Value: 3 to 5, 4 to 6 dry
Chroma: 2 to 4
Texture: loam or silt loam

C horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam, silt loam, or silty clay loam

Buse Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Glacial till
Slope: 3 to 35 percent

Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciudolls

Typical pedon:
Buse loam, 2,400 feet east and 155 feet south of the northwest corner of sec. 34, T. 132 N., R. 43 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common fine and medium roots throughout; common fine irregular masses of lime; about 2 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—8 to 22 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; common medium irregular masses of lime; about 2 percent gravel; violent effervescence; moderately alkaline; clear smooth boundary.

Bk2—22 to 40 inches; light olive brown (2.5Y 5/4) loam; few fine distinct light brownish gray (2.5Y 6/2) relict redoximorphic depletions and prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; weak fine subangular blocky structure; friable; common coarse irregular threads of lime; about 2 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

C—40 to 60 inches; light olive brown (2.5Y 5/4) loam; common medium distinct grayish brown (2.5Y 5/2) relict redoximorphic depletions and few prominent light olive brown (2.5Y 5/6) relict redoximorphic concentrations; massive; friable; about 2 percent gravel; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Cavour Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic Calcic Natrudolls

Typical pedon:
Cavour loam, 162 feet east and 51 feet north of the southwest corner of sec. 19, T. 122 N., R. 49 W (Colors are for moist soil unless otherwise stated.).

A—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine and medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

E—6 to 8 inches; dark gray (10YR 4/1) and very dark gray (10YR 3/1) silt loam, gray (10YR 5/1 and 10YR 6/1) dry; weak thin platy structure; slightly hard, very friable; neutral; abrupt wavy boundary.

Btn1—8 to 13 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; moderate coarse columnar structure parting to strong medium and fine blocky; extremely hard, very firm, sticky and plastic; thin light gray (10YR 6/1) caps about 1/4 inch thick on tops of columns; neutral; gradual irregular boundary.

Btn2—13 to 19 inches; black (10YR 2/1) clay, dark gray (10YR 4/1) dry; weak medium and fine prismatic structure parting to strong medium and fine blocky; extremely hard, firm, sticky and plastic; moderately alkaline; clear wavy boundary.

Btnyz—19 to 24 inches; very dark grayish brown (2.5Y 3/2) clay, dark gray (5Y 4/1) dry; moderate fine and medium blocky structure; very hard, firm, sticky and plastic; common fine and medium accumulations of gypsum and other salts; moderately alkaline; gradual wavy boundary.

Byz—24 to 32 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; moderate medium and coarse subangular blocky structure; very hard, firm, sticky and plastic; common fine and medium accumulations of gypsum and other salts; slight effervescence; moderately alkaline; gradual wavy boundary.

C1—32 to 43 inches; olive brown (2.5Y 4/4) clay loam, light brownish gray (2.5Y 6/2) dry; common fine distinct gray (2.5Y 5/1) dry redoximorphic depletions and prominent yellowish brown (10YR 5/6) dry redoximorphic concentrations; massive; hard, firm, sticky and plastic; few to common fine and medium accumulations of gypsum and other salts; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—43 to 60 inches; olive brown (2.5Y 4/4) clay loam, light brownish gray (2.5Y 6/2) dry; common fine prominent yellowish red (5YR 5/8) dry and strong brown (7.5YR 5/6) dry redoximorphic concentrations and common medium distinct gray (5Y 5/1) dry redoximorphic depletions; massive; hard, firm, sticky and plastic; few to common fine and medium accumulations of gypsum and other salts; strong effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 35 inches
Depth to lime: 14 to 35 inches
Depth to gypsum or other salts: 16 to 45 inches

A horizon:
Hue: 10YR or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 0 or 1
Texture: loam, silt loam, or clay loam

E horizon:
Value: 2 to 5, 3 to 7 dry
Chroma: 1 or 2
Texture: silt loam, loam, or fine sandy loam
Notes: The E horizon is mixed with the A horizon in some cultivated pedons.

Btn horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4, 3 to 5 dry
Chroma: 1 to 3
Texture: clay loam, clay, silty clay, or silty clay loam
Notes: It has an exchangeable sodium percentage of 10 to 20

Byz horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 or 5, 5 or 6 dry
Chroma: 1 to 3
Texture: loam, clay loam, silty clay loam, silty clay, or clay

C horizon:
Hue: 2.5Y or 5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 1 to 4
Texture: loam or clay loam

Colvin Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Terraces and uplands
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical pedon:
Colvin silty clay loam, 75 feet north and 65 feet east of the southwest corner, sec. 18, T. 136 N., R. 60 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 10 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak coarse prismatic structure parting to moderate medium granular; hard, friable, sticky and plastic; many roots; many fine pores; strong effervescence; slightly alkaline; clear wavy boundary.

Bkg1—10 to 20 inches; gray and olive gray (5Y 6/1 and 5/2) silty clay loam, gray and white (N 6/0 and 8/0) dry; very weak medium subangular blocky structure parting to weak fine granular; hard, friable, slightly sticky and plastic; common roots; common fine pores; few masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg2—20 to 30 inches; light olive gray and olive gray (5Y 6/2 and 5/2) silty clay loam, light gray and gray (5Y 7/1 and 6/1) dry; common medium distinct light olive brown (2.5Y 5/6) redoximorphic concentrations; very weak fine subangular blocky structure; hard, friable, slightly sticky and plastic; few roots; common pores; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg—30 to 60 inches; olive gray (5Y 5/2) silty clay loam, light gray (5Y 7/2) dry; many large prominent yellowish brown (10YR 5/8) and few medium prominent yellowish red (5YR 5/6) redoximorphic concentrations; massive; hard, friable, sticky and plastic; strong effervescence in upper part, gradually decreases to slight effervescence at 50 inches; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Depth to the calcic horizon: 4 to 16 inches
Notes: Some pedons have an ABk, Bkz, or 2C horizon.

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Chroma: 0 or 1

Bk horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 7, 5 to 8 dry
Chroma: 0 to 2

Cresbard Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic, frigid Glossic Udic Natrudolls

Typical pedon:
Cresbard loam, 1,300 feet south and 120 feet west of the northeast corner of sec. 35, T. 115 N., R. 59 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; slightly hard, very friable, nonsticky and nonplastic; many very fine and fine roots throughout; common very fine vesicular and few tubular pores; moderately acid; abrupt smooth boundary.

E—9 to 10 inches; very dark grayish brown (10YR 3/2) loam, light gray (10YR 6/1) dry; weak fine and medium platy structure; slightly hard, very friable, nonsticky and nonplastic; common very fine and fine roots; common very fine vesicular and tubular pores; slightly acid; clear smooth boundary.

E/B—10 to 14 inches; 60 percent very dark grayish brown (10YR 3/2) (E) and 40 percent black (10YR 2/1) (B) clay loam, light gray (10YR 6/1)

(E) and dark gray (10YR 4/1) (B) dry; moderate medium prismatic structure parting to moderate very fine and fine blocky; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine tubular and common vesicular pores; slightly acid; clear smooth boundary.

Btn1—14 to 28 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and very plastic; common very fine and fine roots; common very fine tubular pores; neutral; gradual wavy boundary.

Btn2—28 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) dry; moderate medium prismatic structure parting to strong medium blocky; extremely hard, firm, moderately sticky and moderately plastic; common very fine and fine roots throughout; common very fine tubular pores; common prominent dark gray (10YR 4/1) dry continuous clay films on vertical and horizontal faces of peds; about 1 percent gravel; neutral; clear wavy boundary.

Bk—34 to 55 inches; dark grayish brown (2.5Y 4/2) clay loam, grayish brown (2.5Y 5/2) dry; many coarse faint gray (10YR 5/1) dry redoximorphic depletions and few fine prominent yellowish brown (10YR 5/6) dry redoximorphic concentrations; moderate medium prismatic structure parting to weak very fine and fine subangular blocky; hard, friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine tubular pores; common medium irregular masses of lime; about 3 percent gravel; strong effervescence; slightly alkaline; gradual irregular boundary.

C—55 to 60 inches; grayish brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) dry; many medium distinct light gray (10YR 6/1) dry redoximorphic depletions and many fine prominent yellowish brown (10YR 5/6) dry redoximorphic concentrations; massive; hard, friable, slightly sticky and slightly plastic; many very fine vesicular and tubular pores; few fine rounded masses of lime; strong effervescence; about 2 percent gravel; slightly alkaline.

Range in Characteristics

Depth to lime: 15 to 40 inches

Ap horizon:
Value: 2 or 3, 3 or 4 dry
Texture: silt loam or loam

E horizon:
Value: 2 to 4, 5 or 6 dry
Texture: loam or silt loam

E/B horizon:
Hue: 10YR or 2.5Y
Value: E part - 2 to 4, 5 or 6 dry; B part - 2 to 4, 3 to 6 dry
Chroma: B part - 1 to 3
Texture: clay loam or silty clay loam

Btn horizon:
Value: 3 to 6 dry
Chroma: 1 to 3
Texture: silty clay, clay loam, or clay
Notes: It contains 35 to 50 percent clay and more than 15 percent fine sand or coarser sand.

Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: clay loam, loam, or silt loam

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: clay loam, loam, or silt loam
Notes: It has nests of gypsum or other salts in some pedons.

Divide Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate in the upper part and very rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon:
Divide loam, 1,050 feet west and 315 feet south of the northeast corner, sec. 4, T. 149 N., R. 60 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; about 5 percent gravel; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ak—8 to 12 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; about 5 percent gravel; few fine masses of lime; violent effervescence; moderately alkaline; abrupt wavy boundary.

Bk—12 to 22 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine roots; about 5 percent gravel; common medium masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

2C1—22 to 26 inches; light olive brown (2.5Y 5/4) gravelly loamy coarse sand, light yellowish brown (2.5Y 6/4) dry; single grain; loose, nonsticky and nonplastic; few fine roots; about 20 percent gravel; strong effervescence; moderately alkaline; clear smooth boundary.

2C2—26 to 60 inches; olive brown (2.5Y 4/4) very gravelly coarse sand, light olive brown (2.5Y 5/4) dry; single grain; loose, nonsticky and nonplastic; about 35 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 20 inches
Depth to lime: 0 to 8 inches
Depth to the calcic horizon: 7 to 16 inches
Depth to sand and gravel: 20 to 40 inches
Notes: Some pedons have an ABk horizon.

A horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 7, 5 to 8 dry
Chroma: 1 to 4
Texture: loam, clay loam, or sandy clay loam

2C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: sand, coarse sand, or loamy coarse sand
Notes: It has 5 to 40 percent gravel. It is stratified in some pedons.

Dooley Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate in the upper part and slow in the lower part
Landform: Till plains
Parent material: Eolian over glacial till
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Argiustolls

Typical pedon:
Dooley fine sandy loam, 1,320 feet south and 75 feet west of the northeast corner, sec. 33, T. 32 N., R. 58 E. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches, dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate fine crumb structure; slightly hard, very friable, slightly sticky and nonplastic; many very fine roots; 1 percent pebbles; neutral (pH 6.8); clear smooth boundary.

Bt—6 to 15 inches; brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate medium prismatic structure; hard, very friable, sticky and plastic; thin continuous clay film on faces of peds and clay bridging between sand grains; many very fine roots; many very fine tubular pores; 3 percent pebbles; moderately alkaline (pH 8.0); gradual wavy boundary.

Bk—15 to 24 inches; grayish brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; hard, very friable, nonsticky and nonplastic; many very fine vertical roots; many very fine tubular pores; 10 percent pebbles; disseminated lime and common fine masses of lime; lime casts on underside of pebbles; strong effervescence; moderately alkaline (pH 8.2); clear wavy boundary.

2BCk—24 to 36 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak

coarse prismatic structure; hard, friable, sticky and plastic; common very fine roots; common very fine tubular pores; 10 percent pebbles; small masses of lime and lime casts on underside of pebbles; violent effervescence; moderately alkaline (pH 8.4); gradual wavy boundary.

2C—36 to 60 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium platy; hard, friable, very sticky and very plastic; few roots; few pores; 10 percent pebbles and 1 percent stones; disseminated lime; violent effervescence; moderately alkaline (pH 8.4)

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches
Depth to lime: 20 to 26 inches
Depth to glacial till: 23 to 39 inches

Ap horizon:
Value: 3 or 4, 2 or 3 moist
Texture: fine sandy loam or sandy loam

Bk horizon:
Notes: Some pedons do not have a Bk horizon above the till.

2BCk horizon:
Value: 5 to 7, 4 or 5 moist
Chroma: 2 or 3
Texture: clay loam or loam

Easby Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent
Notes: These soils are saline.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical pedon:
Easby clay loam, 2,125 feet west and 525 feet south of the northeast corner of sec. 4, T. 160 N., R. 59 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; very hard, friable, sticky and plastic; few fine roots; few fine masses of salt; slight effervescence; moderately alkaline; abrupt smooth boundary.

ABkyz—7 to 11 inches; dark gray (10YR 4/1) clay loam, gray (10YR 6/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, sticky and slightly plastic; few very fine roots; few fine masses of salt and gypsum; strong effervescence; moderately alkaline; clear irregular boundary.

Bky—11 to 22 inches; light brownish gray (2.5Y 6/2) clay loam, light gray (2.5Y 7/2) dry; few fine prominent dark yellowish brown (10YR 4/6) and common medium prominent brownish yellow (10YR 6/6) redoximorphic concentrations; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, sticky and slightly plastic; about 2 percent gravel; common fine masses of gypsum; few fine masses of lime; violent effervescence; moderately alkaline; clear irregular boundary.

C1—22 to 30 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; common medium distinct light olive brown (2.5Y 5/4) and few medium prominent dark yellowish brown (10YR 4/6) redoximorphic concentrations and gray (10YR 6/1) redoximorphic depletions; massive; slightly hard, friable, sticky and plastic; about 5 percent gravel; few fine masses of gypsum; few fine masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—30 to 43 inches; grayish brown (2.5Y 5/2) loam, light brownish gray (2.5Y 6/2) dry; few medium prominent dark brown (10YR 3/3), few fine prominent dark red (2.5YR 3/6) and many medium prominent dark brown (7.5YR 4/4) redoximorphic concentrations and common medium prominent gray (10YR 6/1) redoximorphic depletions; massive; slightly hard, friable, sticky and plastic; about 10 percent gravel; strong effervescence; moderately alkaline; gradual wavy boundary.

C3—43 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine prominent dark red (2.5YR 3/6) and strong brown (7.5YR 4/6) redoximorphic concentrations and gray (10YR 6/1) redoximorphic depletions; massive; slightly hard, friable, sticky and plastic; about 10 percent gravel; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 25 inches
Notes: The mollic epipedon has an electrical conductivity of more than 16 mmhos/cm and a SAR of more than 13.

Ap horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3, 3 or 4 dry
Chroma: 0 or 1
Texture: clay loam or loam

ABkyz horizon:
Hue: 10YR or neutral
Value: 3 or 4, 5 or 6 dry
Chroma: 0 or 1

Bky horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 4 to 6, 5 to 7 dry
Chroma: 0 to 2
Texture: clay loam, loam, or silty clay loam

C horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 to 5, 5 to 7 dry
Chroma: 0 to 4

Eckman Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Coarse-silty, mixed, superactive, frigid Calcic Hapludolls

Typical pedon:
Eckman silt loam, 1,735 feet east and 495 feet north of the southwest corner of sec. 32, T. 126 N., R. 51 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; very dark gray (10YR 3/1), broken face, silt loam, dark gray (10YR 4/1), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; slightly acid; abrupt smooth boundary.

Bw1—8 to 13 inches; grayish brown (10YR 5/2), broken face, silt loam, dark grayish brown (10YR 4/2), broken face, dry; weak coarse prismatic structure; friable, slightly sticky and slightly plastic; slightly acid; gradual wavy boundary.

Bw2—13 to 19 inches; dark grayish brown (10YR 4/2), broken face, silt loam, grayish brown (10YR 5/2), broken face, dry; weak coarse prismatic structure; friable, slightly sticky and slightly plastic; slightly acid; clear wavy boundary.

Bk—19 to 40 inches; light olive brown (2.5Y 5/4), broken face, silt loam, pale yellow (2.5Y 7/4), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; strongly effervescent throughout (HCl, unspecified); neutral; gradual wavy boundary.

C1—40 to 48 inches; light olive brown (2.5Y 5/4), broken face, silt loam, pale yellow (2.5Y 7/4), broken face, dry; weak medium subangular blocky structure; friable, slightly sticky and slightly plastic; slightly effervescent throughout (HCl, unspecified); neutral; clear wavy boundary.

C2—48 to 60 inches; light olive brown (2.5Y 5/4) very fine sandy loam, pale yellow (2.5Y 7/4) dry; massive; very friable, slightly sticky and slightly plastic; slightly effervescent throughout (HCl, unspecified); neutral.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 36 inches

Exline Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are saline-sodic. These soils are drier than is definitive of the Exline series. This difference, however, does not alter the usefulness or behavior of the soils.

Taxonomic class: Fine, smectitic, frigid Leptic Natrudolls

Typical pedon:
Exline silt loam, 484 feet south and 120 feet east of the northwest corner of sec. 11, T. 122 N., R. 64 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 2 inches; black (10YR 2/1), broken face, silt loam, dark gray (10YR 4/1), broken face, dry; weak fine granular and weak very fine granular structure; soft, friable, slightly sticky; slightly acid; clear smooth boundary.

E—2 to 3 inches; very dark gray (10YR 3/1), broken face, silt loam, gray (10YR 5/1), broken face, dry; weak very thin platy structure; soft, friable, slightly sticky; slightly acid; abrupt smooth boundary.

Btn—3 to 7 inches; black (10YR 2/1), broken face, clay, dark gray (10YR 4/1) dry; strong medium columnar structure parting to strong fine and medium subangular blocky; very hard, very firm, very sticky and very plastic; gray (10YR 5/1) dry skeletans on tops of columns and on faces of peds; continuous clay films on vertical faces of peds; neutral; clear wavy boundary.

Btnz—7 to 11 inches; black (10YR 2/1), broken face, and very dark brown (10YR 2/2), broken face, clay, dark gray (10YR 4/1), crushed, dry; moderate medium prismatic structure parting to strong very fine and fine subangular blocky; very hard, very firm, very sticky and very plastic; continuous clay films on vertical faces of peds; common fine and medium salt masses pedogenic throughout; moderately alkaline; gradual wavy boundary.

Btknz—11 to 19 inches; very dark gray (10YR 3/1), broken face, clay, gray (10YR 5/1), broken face, dry; weak very coarse prismatic structure parting to moderate very fine subangular blocky and moderate fine subangular blocky; very hard, very firm, very sticky and very plastic; continuous clay films on vertical faces of peds; many fine and medium salt masses pedogenic throughout; common fine masses of lime pedogenic throughout; strongly effervescent throughout, (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bkz—19 to 23 inches; grayish brown (2.5Y 5/2), broken face, clay, light brownish gray (2.5Y 6/2), broken face, dry; weak very fine subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine salt masses pedogenic throughout; common fine and medium masses of lime pedogenic throughout; common fine tongues of very dark brown (10YR 2/2) moist; strongly effervescent throughout, (HCl, unspecified); strongly alkaline; gradual wavy boundary.

Bk—23 to 34 inches; grayish brown (2.5Y 5/2), broken face, silty clay loam, light brownish gray (2.5Y 6/2), broken face, dry; weak very fine and fine subangular blocky structure; very hard, firm, moderately sticky and moderately plastic; many coarse tongues of very dark grayish brown (2.5Y 3/2) moist; few fine salt masses pedogenic throughout; few fine masses of lime pedogenic throughout; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic and common fine distinct gray (5Y 5/1) iron depletions pedogenic throughout; strongly effervescent throughout, (HCl, unspecified); strongly alkaline; gradual wavy boundary.

C—34 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam, light gray (2.5Y 7/2) dry; massive; firm, moderately sticky and moderately plastic; common fine and medium masses of lime pedogenic at top of horizon; many fine and medium prominent yellowish brown (10YR 5/6) masses of iron accumulations pedogenic and many fine and medium prominent gray (5Y 5/1) iron depletions pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Depth to lime: 8 to 28 inches
Depth to gypsum or other salts: 6 to 16 inches
Exchangeable sodium percentage: Greater than 15 percent above a depth of 16 inches

E horizon:
Notes: The E horizon is commonly absent in cultivated pedons.

Bt horizon:
Notes: The clay content ranges from 35 to 55 percent.

Farnuf Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Argiustolls

Typical pedon:
Farnuf loam, 1,600 feet west and 1,240 feet south

of the northeast corner, sec. 36, T. 18 N., R. 6 E. (Colors are for moist soil unless otherwise stated.)

A—0 to 7 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; moderate very thin platy structure in the upper part and moderate medium prismatic structure in the lower part with plates and prisms that separate to moderate very fine granules; hard, very friable, slightly sticky and slightly plastic; many fine and medium roots; many very fine and fine pores; neutral (pH 7.4); clear smooth boundary.

Bt—7 to 15 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; strong medium prismatic structure parting to strong fine and medium subangular blocky; very hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine and few medium pores; continuous faint dark grayish brown (10YR 4/2) dry clay films on faces of peds; slightly alkaline (pH 7.6); clear wavy boundary.

Bk1—15 to 24 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; moderate medium prismatic structure that separates to weak medium and fine blocky; hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine and few medium pores; few masses of lime; strong effervescence; moderately alkaline (pH 8.3); diffuse wavy boundary.

Bk2—24 to 36 inches; grayish brown (10YR 5/2) loam, light gray (10YR 7/2) dry; weak coarse blocky structure; hard, friable, sticky and slightly plastic; common fine and very fine roots; common fine and very fine pores; 5 percent pebbles; common masses of lime; continuous faint coatings of lime on pebbles; strong effervescence; moderately alkaline (pH 8.4); diffuse wavy boundary.

BC—36 to 60 inches; brown (10YR 5/3) loam consisting of layers of stratified sandy clay loam and fine sandy loam, very pale brown (10YR 7/3) dry; massive; hard, very friable, sticky and slightly plastic; few fine and very fine roots; common fine and very fine pores; disseminated lime; strong effervescence; strongly alkaline (pH 8.5).

Range in Characteristics

Mollic epipedon thickness: 7 to 15 inches
Depth to lime: 10 to 25 inches
Notes: Some pedons have a C horizon. The Farnuf soil in Map Unit 2178 is a taxadjunct because it has less than 15 percent fine sand or coarser sand. This difference, however, does not alter the usefulness or behavior of the soils.

Ap horizon:
Value: 2 or 3, 4 or 5 dry

Bt horizon:
Hue: 10YR or 2.5Y
Value: 3 or 4, 4 or 5 dry
Chroma: 2 to 4
Texture: loam, clay loam, or silty clay loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam, silt loam, clay loam, or silty clay loam

BC horizon:
Value: 4 to 6, 5 to 7 dry
Texture: loam or clay loam

Grano Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, frigid Typic Endoaquerts

Typical pedon:
Grano silty clay, 1,790 feet north and 90 feet east of the southwest corner of sec. 26, T. 135 N., R. 66 W. (Colors are for moist soil unless otherwise stated.)

Oe—0 to 3 inches; black fibrous peat.

Ag—3 to 19 inches; black (5Y 2/1), broken face, silty clay, dark gray (5Y 4/1), broken face, dry; weak coarse prismatic structure parting to strong fine angular blocky; extremely hard, firm, very sticky and very plastic; many fine roots in upper part and common roots in lower part; few fine lime threads pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; clear irregular boundary.

Cg1—19 to 39 inches; olive gray (5Y 4/2), broken face, silty clay, light olive gray (5Y 6/2), broken face, dry; strong fine angular blocky structure; extremely hard, firm, very sticky and very plastic; few pores; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg2—39 to 51 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; massive; extremely hard, firm, very sticky and very plastic; many medium prominent light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; strongly effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Cg3—51 to 60 inches; dark gray (5Y 4/1) clay loam, gray (5Y 5/1) dry; massive; extremely hard, firm, moderately sticky and moderately plastic; few fine prominent light olive brown (2.5Y 5/4) masses of iron accumulation pedogenic throughout; 3 percent mixed gravel; slightly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
10 to 40 inch particle-size control section: averages 50 to 60 percent clay
Notes: The soil is silty clay or clay throughout.

Hamerly Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately slow
Landform: Till plains and lake plains
Parent material: Glacial till
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon:
Hamerly loam, 2,090 feet south and 95 feet west of the northeast corner, sec. 26, T. 132 N., R. 56 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak medium subangular blocky structure parting to moderate medium granular; friable, slightly sticky; strong effervescence; abrupt smooth boundary.

Bk1—8 to 18 inches; light brownish gray (2.5Y 6/2) loam; weak medium and fine subangular blocky structure; friable; violent effervescence; gradual wavy boundary.

Bk2—18 to 25 inches; light brownish gray (2.5Y 6/2) and light olive brown (2.5Y 5/4) loam; weak medium subangular blocky structure; friable; few masses of lime; violent effervescence; gradual wavy boundary.

C—25 to 60 inches; light olive brown (2.5Y 5/4) and olive brown (2.5Y 4/4) loam; common medium distinct gray (2.5Y 5/1) redoximorphic depletions and yellowish brown (10YR 5/6) redoximorphic concentrations; weak medium blocky structure; firm; strong effervescence.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 0 to 7 inches
Depth to the calcic horizon: 5 to 16 inches
Notes: Some pedons have a BCk horizon.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2

Bk horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6, 5 to 8 dry
Chroma: 1 to 4
Texture: loam, silt loam, or clay loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 1 to 4
Texture: loam, silt loam, or clay loam

Hamlet Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate in the upper part and moderate or moderately slow in the lower part
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Oxyaquic Hapludolls

Typical pedon:
Hamlet loam, 900 feet east and 25 feet south of the

northwest corner, sec. 5, T. 161 N., R. 85 W. (Colors are for moist soil unless otherwise stated)

Ap—0 to 8 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak and moderate fine and medium granular structure; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

Bw1—8 to 15 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; common fine faint brown (10YR 5/3) redoximorphic concentrations in lower part; moderate medium prismatic structure parting to moderate medium and fine angular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; few thin tongues of A horizon extend into the horizon; few thin dark gray (10YR 4/1) coatings on faces of prisms; few pebbles; neutral; clear irregular boundary.

Bw2—15 to 19 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; common fine faint gray (5Y 5/1) redoximorphic depletions and common fine distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few stones; few small masses of lime; slightly alkaline; clear irregular boundary.

Bk—19 to 37 inches; light olive brown (2.5Y 5/4) loam, light gray (2.5Y 7/2) dry; common medium distinct gray (5Y 5/1) and light gray (5Y 7/1) redoximorphic depletions; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few pebbles; common masses of lime; violent effervescence; moderately alkaline; gradual wavy boundary.

C—37 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; common medium distinct light yellowish brown (2.5Y 6/4) moist and few fine prominent strong brown (7.5YR 5/6) redoximorphic concentrations; massive; very hard, firm, sticky and slightly plastic; few pebbles; strong effervescence; common gypsum crystals in lower part; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 13 to 26 inches
10 to 40 inch particle-size control section: 30 to 50 percent sand
Percent rock fragments: 1 to 8 percent

Ap horizon:
Value: 2 or 3, 4 or 5 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 2 to 4
Texture: loam or clay loam
Notes: It has few to many, faint or distinct redoximorphic features, mainly in the lower part.

Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Texture: loam or clay loam
Notes: It contains 15 to 25 percent calcium carbonate equivalent disseminated or segregated in masses.

C horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam
Notes: It contains few to many redoximorphic features.

Haplustolls Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Glacial till
Slope: 0 to 9 percent
Notes: These soils are calcareous.

Taxonomic class: Haplustolls

Typical pedon:
Haplustolls, 1,025 feet west and 2,150 feet south of the northeast corner of sec. 16, T. 162 N., R. 94 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; about 3 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

A1—4 to 9 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; common iron stains; about 3 percent gravel; slight effervescence; slightly alkaline; gradual wavy boundary.

A2—9 to 16 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; weak fine prismatic structure parting to moderate fine subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; few fine and common very fine roots; many iron stains; about 4 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

C1—16 to 32 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, firm, sticky and plastic; few very fine roots; common lignite chips; about 8 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—32 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, firm, sticky and plastic; common lignite chips; about 6 percent gravel; violent effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Depth to lime: 0 to 12 inches

A horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 2 or 3 moist
Chroma: 1 to 3

C horizon:
Hue: 10YR, 2.5Y or 5Y
Value: 4 to 7, 3 to 6 moist
Chroma: 2 to 6
Texture: loam, clay loam, silty clay loam, or sandy clay loam

Harriet Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent

Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic, frigid Typic Natraquolls

Typical pedon:
Harriet loam, 1,650 feet east and 40 feet north of the southwest corner, sec. 34, T. 139 N., R. 79 W. (Colors are for moist soil unless otherwise stated.)

E—0 to 2 inches; very dark gray (N 3/0) loam, gray (N 5/0 and 6/0) dry; weak thick and medium platy structure; friable; many fine roots; common fine pores; few salt crystals visible when soil is dry; moderately alkaline; abrupt wavy boundary.

Btn—2 to 6 inches; black (N 2/0) clay loam, dark gray (N 4/0) dry; moderate medium columnar structure; extremely hard, firm; coatings of very dark gray (N 3/0) on faces of peds; gray (N 5/0 dry) on tops and sides of columns; slight effervescence on inside of columns; strongly alkaline; clear wavy boundary.

Btnz—6 to 18 inches; very dark grayish brown (2.5Y 3/2) clay loam, grayish brown (2.5Y 5/2) dry; moderate coarse prismatic and weak medium subangular blocky structure; very hard, firm; few roots; common medium pores; common fine white salt crystals; strong effervescence; strongly alkaline; gradual wavy boundary.

Bz1—18 to 28 inches; dark grayish brown (2.5Y 4/2) loam, grayish brown and light brownish gray (2.5Y 5/2 and 6/2) dry; weak coarse prismatic structure; very hard, firm; few fine roots; few medium and fine pores; fine salt crystals visible when dry; violent effervescence; strongly alkaline; abrupt smooth boundary.

2Bz2—28 to 38 inches; light olive brown (2.5Y 5/3) very fine sandy loam, light yellowish brown (2.5Y 6/3) dry; weak coarse prismatic and weak coarse and medium subangular blocky structure; very hard, friable; few fine pores; common very fine salt crystals that are visible when dry; strong effervescence; strongly alkaline; abrupt smooth boundary.

3Ab—38 to 40 inches; very dark gray (N 3/0) clay loam, dark gray (N 4/0) dry; few medium distinct olive brown (2.5Y 4/3) redoximorphic concentrations; weak coarse prismatic structure; very hard, firm; few fine roots; strong effervescence; strongly alkaline; abrupt boundary.

3C—40 to 60 inches; olive brown (2.5Y 4/3) stratified loam and clay loam, light yellowish brown

(2.5Y 6/3) dry; weak coarse and medium subangular blocky structure; very hard, friable; strong effervescence; strongly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 28 inches
Depth to lime: 0 to 10 inches
Notes: Some pedons have an A, Bk, BCk, or C horizon.

E horizon:
Hue: 10YR, 2.5Y, or neutral
Value: 2 to 5, 4 to 7 dry
Chroma: 0 or 1

Btn horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 to 4
Chroma: 0 to 2
Texture: clay loam, silty clay loam, clay, or silty clay

Bz and 2Bz horizons:
Hue: 2.5Y or 5Y
Value: 3 to 5

3C horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5
Notes: Some pedons do not have a 3C horizon.

Hegne Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 2 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine, smectitic, frigid Typic Calciaquerts

Typical pedon:
Hegne silty clay, 600 feet south and 2,100 feet east of the northwest corner of sec. 22, T. 157 N., R. 49 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 10 inches; black (5Y 2.5/1) silty clay, very dark gray (5Y 3/1) dry; common fine distinct olive gray (5Y 4/2) redoximorphic depletions; strong fine and medium subangular blocky structure; firm; few fine and medium roots; many fine rounded light gray (10YR 7/2) masses of lime; slight effervescence; slightly alkaline; clear wavy boundary.

Bkssg1—10 to 18 inches; about 60 percent olive gray (5Y 4/2) and 40 percent dark gray (5Y 4/1) silty clay, light gray (5Y 6/1) and gray (5Y 5/1) dry; moderate medium subangular blocky structure; firm; few fine roots; few distinct intersecting slickensides tilted less than 45 degrees from horizontal; cracks filled with A material 1/4 to 3 inches wide and 2 to 4 feet apart; many fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bkssg2—18 to 34 inches; olive gray (5Y 5/2) silty clay, light olive gray (5Y 6/2) dry; common fine faint dark gray (5Y 4/1) redoximorphic depletions; moderate fine and medium subangular blocky structure; firm; few very fine roots; few distinct intersecting slickensides tilted less than 60 degrees from horizontal; cracks filled with A material 1/4 to 2 inches wide and 2 to 4 feet apart; many fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bg—34 to 50 inches; olive gray (5Y 4/2) silty clay; friable; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak fine and medium subangular blocky structure; few fine masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Cg1—50 to 68 inches; olive gray (5Y 5/2) silty clay; weak fine and medium subangular blocky soil fragments parting to weak fine platy; common medium distinct gray (5Y 5/1) redoximorphic depletions and medium prominent strong brown (7.5YR 4/6) and common fine reddish yellow (7.5YR 6/6) redoximorphic concentrations; firm; few medium lime coats on faces of peds; strong effervescence; moderately alkaline; clear wavy boundary.

Cg2—68 to 80 inches; olive (5Y 5/3) laminated silty clay; common medium distinct gray (5Y 5/1) redoximorphic depletions and common medium prominent strong brown (7.5YR 5/6) and (7.5YR 5/8) redoximorphic concentrations; laminates part to weak fine platy fragments which part to weak fine subangular blocky fragments; firm; few medium irregular light gray (2.5Y 72) lime coats on faces of peds; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Calcium carbonate equivalent: 10 to 30 percent
10 to 40 inch particle-size control section: 40 to 60 percent noncarbonate clay and less than 5 percent sand

Ap horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3
Chroma: 0 or 1
Texture: silty clay, clay, or silty clay loam

Bkssg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6
Chroma: 1 or 2
Texture: clay or silty clay

Bg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 6
Chroma: 1 or 2
Texture: clay or silty clay

Cg horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6
Chroma: 1 to 3
Texture: clay or silty clay

Heil Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Very slow
Landform: Depressions
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic, frigid Typic Natraquerts

Typical pedon:
Heil silty clay, 650 feet west and 20 feet south of the northeast corner, sec. 14, T. 135 N., R. 100 W. (Colors are for moist soil unless otherwise stated.)

E—0 to 3 inches; dark gray (10YR 4/1) silty clay, light gray (10YR 6/1) dry; common fine distinct brown (10YR 5/3) and dark brown (10YR 4/3) redoximorphic concentrations; moderate fine subangular blocky and weak thin platy structure; firm; many roots and fine pores; neutral; abrupt wavy boundary.

Btn—3 to 7 inches; very dark gray (2.5Y 3/1) silty clay, gray (2.5Y 5/1) dry; strong coarse and medium columnar structure parting to strong coarse medium and fine angular blocky; extremely hard, very firm; roots in cracks; few pores; slightly alkaline; gradual smooth boundary.

Btng—7 to 24 inches; very dark gray (5Y 3/1) silty clay, gray (5Y 5/1) dry; strong very coarse prismatic structure parting to strong coarse and medium angular blocky; extremely hard, very firm; few roots; surface of peds have a glossy appearance when moist; few tongues of E (5Y 6/1) dry; moderately alkaline; gradual wavy boundary.

Bg—24 to 38 inches; dark gray (5Y 4/1) silty clay, light gray (5Y 6/1) dry; moderate coarse angular blocky structure; extremely hard, very firm; strong effervescence; moderately alkaline; gradual wavy boundary.

Byg1—38 to 44 inches; dark gray (5Y 4/1) silty clay, light gray (5Y 6/1) dry; weak coarse and fine angular blocky structure; very firm; few fine gypsum crystals; strong effervescence; moderately alkaline; diffuse boundary.

Byg2—44 to 52 inches; olive (5Y 4/3) silty clay, pale olive (5Y 6/3) dry; weak coarse subangular blocky structure; very firm; common gypsum crystals; strong effervescence; strongly alkaline; gradual boundary.

Cg—52 to 60 inches; olive (5Y 5/4) silty clay, pale olive (5Y 6/3) dry; many strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) redoximorphic concentrations and gray (5Y 5/1) redoximorphic depletions; massive; few large white masses of lime; strong effervescence; strongly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 45 inches
Depth to lime: 12 to 40 inches
Depth to the Btn horizon: 1 to 4 inches
Notes: Some pedons have an A horizon up to 3 inches thick. Some pedons have a Btkn or Bk horizon.

E horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 5, 4 to 8 dry

Chroma: 1 or 2
Texture: silt loam, silty clay loam, or silty clay

Btn horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4, 4 to 6 dry
Chroma: 1 or 2
Texture: silty clay or clay

Bg and Byg horizons:
Hue: 2.5Y or 5Y
Value: 3 to 5, 4 to 7 dry
Texture: silty clay, clay, silty clay loam, or clay loam

Cg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4
Texture: silty clay, clay, silty clay loam, or clay loam

Korchea Series

Depth Class: Very deep
Drainage Class: Well drained
Permeability: Moderate
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 3 percent
Notes: These soils are calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, calcareous, frigid Mollic Ustifluvents

Typical pedon:
Korchea loam, 790 feet south and 110 feet west of the northeast corner, sec. 36, T. 129 N., R. 102 W. (Colors are for dry soil unless otherwise stated.)

A—0 to 6 inches; grayish brown (10YR 5/2) stratified loam, very dark grayish brown (10YR 3/2) moist; weak coarse and medium subangular blocky structure parting to moderate fine granular; hard, very friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slight effervescence; moderately alkaline; clear smooth boundary.

C1—6 to 15 inches; grayish brown (10YR 5/2) stratified loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; many fine pores; slight effervescence; moderately alkaline; abrupt smooth boundary.

C2—15 to 18 inches; grayish brown (2.5Y 5/2) stratified fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable, slightly sticky, and slightly plastic; common fine roots; many fine pores; slight effervescence; moderately alkaline; abrupt smooth boundary.

C3—18 to 36 inches; grayish brown (2.5Y 5/2) stratified loam, silt loam, and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, slightly sticky, and slightly plastic; common fine roots in upper part, few fine roots in lower part; very few fine masses of carbonates; strong effervescence; moderately alkaline; gradual smooth boundary.

C4—36 to 60 inches; grayish brown (2.5Y 5/2) stratified fine sandy loam and loam, grayish brown (2.5Y 4/2) moist; massive; slightly hard and hard, friable, slightly sticky and slightly plastic; few fine roots; slight effervescence; moderately alkaline.

Range in Characteristics

Depth to lime: 0 to 5 inches

A horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 5

C horizon:
Value: 5 or 6, 3 to 5 moist
Chroma: 2 to 4
Texture: sandy loam to silty clay loam
Notes: It is stratified. It has sand or fine sand below a depth of 40 inches in some pedons.

Kratka Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately rapid or rapid in the upper part and moderate or moderately slow in the lower part
Landform: Lake plains or deltas
Parent material: Sandy glaciolacustrine or glaciofluvial deposits over loamy glaciolacustrine deposits or glacial till
Slope: 0 to 2 percent

Taxonomic class: Sandy over loamy, mixed, superactive, frigid Typic Endoaquolls

Typical pedon:
Kratka fine sandy loam, 1,420 feet north and 250 feet east of the southwest corner, sec. 12, T. 154 N., R. 45 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure parting to weak fine granular; friable; few medium and common very fine and fine roots; about 5 percent gravel; slightly alkaline; abrupt smooth boundary.

A—6 to 11 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak moderate subangular blocky structure parting to weak fine granular; friable; few fine and common very fine roots; about 5 percent gravel; slightly alkaline; clear smooth boundary.

Bw1—11 to 14 inches; dark grayish brown (2.5Y 4/2) fine sandy loam; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; weak medium subangular blocky structure; very friable; few very fine and fine roots; about 5 percent gravel; slightly alkaline; clear smooth boundary.

Bw2—14 to 18 inches; dark grayish brown (2.5Y 4/2) loamy fine sand; common medium distinct light olive brown (2.5Y 5/4 and 5/6) redoximorphic concentrations; weak fine and medium subangular blocky structure; very friable; about 8 percent gravel; slightly alkaline; clear wavy boundary.

Cg1—18 to 25 inches; grayish brown (2.5Y 5/2) fine sand; many coarse distinct light olive brown (2.5Y 5/6) redoximorphic concentrations and common medium faint light brownish gray (2.5Y 6/2) redoximorphic depletions and few medium prominent yellowish brown (10YR 5/6) redoximorphic concentrations; single grain; loose; about 10 percent gravel; slightly alkaline; abrupt wavy boundary.

2Cg2—25 to 31 inches; olive gray (5Y 5/2) loam; common medium prominent light olive brown (2.5Y 5/4) redoximorphic concentrations; massive; friable; about 5 percent gravel; slightly effervescent; slightly alkaline; clear wavy boundary.

2Cg3—31 to 39 inches; olive gray (5Y 5/2) loam; common medium prominent light olive brown (2.5Y 5/4) and few fine prominent yellowish brown (10YR 5/6) redoximorphic concentrations; massive; friable; about 5 percent gravel; strongly effervescent; slightly alkaline; clear smooth boundary.

2Cg4—39 to 80 inches; olive gray (5Y 5/2) clay loam; few medium prominent yellowish brown (10YR 5/6) and common medium prominent light olive brown (2.5Y 5/6) redoximorphic concentrations; massive; friable; about 5 percent gravel; strongly effervescent; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 6 to 18 inches
Depth to lime: 16 to 60 inches
Percent rock fragments: 0 to 5 percent in the upper part and 0 to 8 percent in the 2C horizon.
Depth to loamy glaciolacustrine deposits or glacial till: 20 to 40 inches
Notes: A thin lag line, ranging up to 6 inches thick and containing up to 35 percent rock fragments is at the contact between the upper and lower material in some pedons. Some pedons have Ab, Bkg, 2Bkg, or 2Bg horizons.

A horizon:
Hue: 10YR, 2.5Y, or neutral
Value: 2 or 3
Chroma: 0 to 2
Texture: loamy sand, loamy fine sand, sandy loam, or fine sandy loam

Bw horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6
Chroma: 1 or 2 in the upper part, 3 or 4 in the lower part
Texture: loamy fine sand, fine sand, loamy sand, sand, or fine sandy loam

Cg horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6
Chroma: 2 to 4
Texture: sand, fine sand, loamy fine sand, or loamy sand

2Cg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6
Chroma: 1 to 3
Texture: loam, clay loam, sandy loam, or fine sandy loam where it is glacial till and silt loam, silty clay loam, or very fine sandy loam with thin strata of loamy fine sand or fine sand where it is glaciolacustrine deposits

Krem Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid over moderate
Landform: Uplands
Parent material: Eolian over glacial till
Slope: 0 to 15 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Paleustolls

Typical pedon:
Krem loamy fine sand, 1,850 feet east and 135 feet south of the northwest corner of sec. 17, T. 144 N., R. 85 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; very dark brown (10YR 2/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine and medium granular structure; very friable, nonsticky and nonplastic; common very fine, medium, and coarse roots; very few pebbles; neutral; clear smooth boundary.

A1—7 to 15 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; very friable, nonsticky and nonplastic; common very fine and few fine roots; very few pebbles; neutral; clear wavy boundary.

A2—15 to 25 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; very friable, nonsticky and nonplastic; common very fine and few medium roots; many very fine tubular pores; very few pebbles; krotovina 3 inches in diameter; neutral; abrupt wavy boundary.

BA—25 to 30 inches; dark brown (10YR 4/3) loamy sand, brown (10YR 5/3) dry; weak medium subangular blocky structure; loose, nonsticky and nonplastic; few very fine roots; common very fine and medium tubular pores; about 5 percent rock fragments; slightly alkaline; abrupt irregular boundary.

2Bt—30 to 38 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; common fine distinct strong brown (7.5YR 5/6) dry redoximorphic concentrations; strong coarse prismatic structure parting to strong angular blocky; sticky and plastic; few very fine and fine roots; many very fine tubular pores; many moderately thick clay films on faces of peds and surface of pores; sandy coatings up to 1/4 inch thick between prisms; about 3 percent rock fragments; some are coated with lime; slightly alkaline; clear irregular boundary.

2Btk—38 to 60 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; common fine distinct strong brown (7.5YR 5/6) dry redoximorphic concentrations; strong very coarse prismatic structure parting to moderate medium and coarse angular blocky; sticky and plastic; few very fine and fine roots along faces of prisms; many very fine tubular pores; many moderately thick dark grayish brown (2.5Y 4/2) clay films on faces of peds and surfaces of pores; sandy coatings up to 1/4 inch thick between prisms; about 3 percent rock fragments; many irregular shaped masses of lime; violent effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: More than 20 inches
Depth to glacial till: 20 to 40 inches
Notes: Some pedons have 2Bk, 2BC, or 2C horizons.

A horizon:
Value: 3 to 5 dry
Chroma: 2 or 3
Texture: loamy fine sand, fine sand, or loamy sand

BA horizon:
Value: 3 or 4, 5 or 6 dry
Chroma: 2 or 3
Texture: loamy sand or loamy fine sand

2Bt horizon:
Hue: 2.5Y or 10YR
Value: 3 or 4, 4 to 6 dry
Chroma: 2 or 3
Texture: clay loam, sandy clay loam, or loam
Notes: It has up to 10 percent rock fragments.

Lehr Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Moderately rapid in the upper part and very rapid in the lower part
Landform: Outwash plains and terraces
Parent material: Glaciofluvial deposits
Slope: 0 to 9 percent

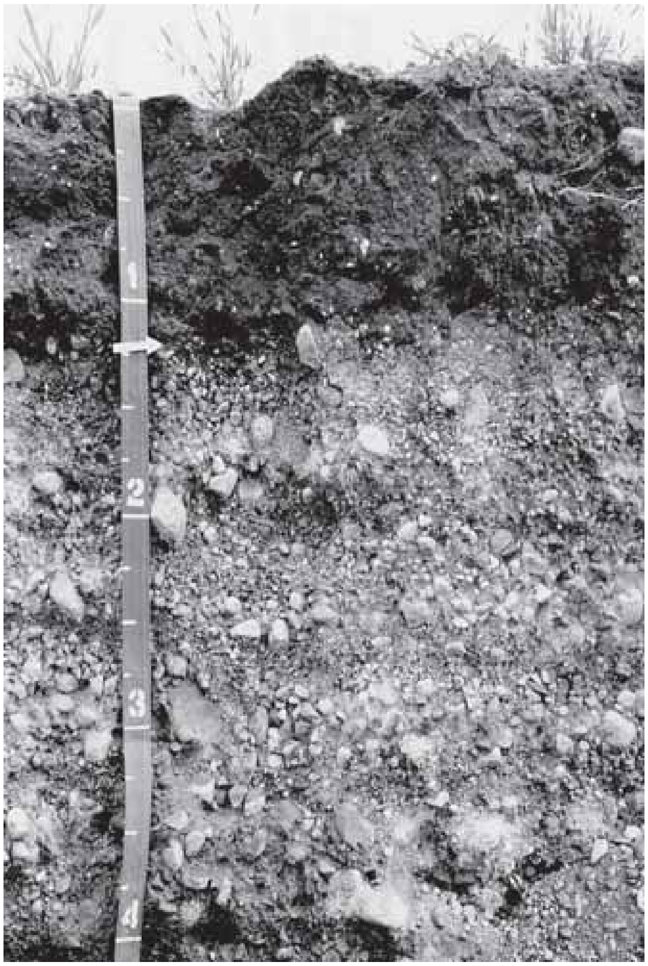

Figure 11. Typical pedon of Lehr loam.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Haplustolls

Typical pedon:
Lehr loam, 1,490 feet north and 625 feet west of the southeast corner, sec. 12, T. 156 N., R. 93 W. (Colors are for moist soil unless otherwise stated.) (fig. 11)

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; about 2 percent gravel; slightly alkaline; abrupt smooth boundary.

Bw—6 to 11 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; about 5 percent gravel; slightly alkaline; gradual wavy boundary.

Bk1—11 to 15 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; moderate medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; about 10 percent gravel; few distinct very dark grayish brown (10YR 3/2) coatings on faces of peds; common medium irregular masses and filaments of lime; thin crusts of lime on undersides of pebbles; violent effervescence; moderately alkaline; clear smooth boundary.

2Bk2—15 to 22 inches; yellowish brown (10YR 5/4) gravelly loamy coarse sand, light yellowish brown (10YR 6/4) and white (10YR 8/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; about 30 percent gravel; many medium irregular masses and filaments of lime; thin crusts of lime on undersides of pebbles; violent effervescence; moderately alkaline; clear smooth boundary.

2C—22 to 60 inches; grayish brown (2.5Y 5/2) and light yellowish brown (2.5Y 6/4) very gravelly coarse sand, light brownish gray (2.5Y 6/2) and pale yellow (2.5Y 7/4) dry; single grain; loose, nonsticky and nonplastic; about 40 percent gravel; thin crusts of lime on undersides of pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 14 to 20 inches
Notes: Some pedons have a 2BCk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 4 or 5 dry
Chroma: 2 to 4
Texture: loam or gravelly loam

Bk horizon:
Notes: Some pedons do not have a Bk horizon.

2C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Texture: coarse sand, sand, or loamy sand
Notes: It has 15 to 60 percent rock fragments

Letcher Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow in the upper part and moderate or moderately rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Calcic Natrudolls

Typical pedon:
Letcher fine sandy loam, 285 feet west and 120 feet north of the southeast corner of sec. 6, T. 124 N., R. 66 W. (Colors are for dry soil unless otherwise stated.)

A1—0 to 8 inches; dark gray (10YR 4/1) fine sandy loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure parting to weak fine and medium granular; slightly hard, very friable; strongly acid; clear smooth boundary.

A2—8 to 12 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; weak medium and coarse subangular blocky structure parting to very weak fine and medium granular; slightly hard, very friable; moderately acid; abrupt smooth boundary.

E—12 to 15 inches; light brownish gray (10YR 6/2) sandy loam, very dark grayish brown (10YR 3/2) moist; few fine faint mottles of yellowish brown (10YR 5/6); weak fine and medium subangular blocky structure parting to very thin platy; slightly hard, very friable; neutral; clear wavy boundary.

Btn—15 to 19 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; strong very coarse columnar structure; extremely hard, firm; light brownish gray (10YR 6/2) coatings on tops of columns; neutral; clear smooth boundary.

Btnk—19 to 25 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak very coarse prismatic structure; hard, very friable; common fine and medium accumulations of salt and lime; slight effervescence; strongly alkaline; clear smooth boundary.

BC—25 to 32 inches; grayish brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, very friable; few fine striations and accumulations of lime; slight effervescence; strongly alkaline; abrupt smooth boundary.

Ab—32 to 40 inches; gray (10YR 5/1) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; very hard, firm; few fine striations and accumulations of lime; slight effervescence; strongly alkaline; abrupt smooth boundary.

Bkb—40 to 48 inches; dark gray (10YR 4/1) sandy loam, black (10YR 2/1) moist; weak fine and medium subangular blocky structure; very hard, friable; many fine striations and accumulations of lime; strong effervescence; strongly alkaline; abrupt smooth boundary.

C—48 to 60 inches; light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/2) sandy loam, dark grayish brown (10YR 4/2) moist; common fine faint redoximorphic concentrations of reddish yellow (7.5YR 6/8) moist; massive hard, friable; strong effervescence; strongly alkaline.

Range in Characteristics

Depth to lime: 10 to 25 inches
Notes: Some pedons have an Ab or Bk horizon.

A horizon:
Value: 3 to 5, 2 or 3 moist

E horizon:
Hue: 10YR or 2.5Y
Value: 4 to 7, 2 to 5 moist
Chroma: 1 or 2
Texture: loamy fine sand, fine sandy loam, or sandy loam
Notes: It ranges from strongly acid to slightly alkaline.

Btn horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5, 3 or 4 moist
Chroma: 2 or 3
Texture: sandy loam, fine sandy loam, or loam

BC horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 3 or 4 moist
Chroma: 2 or 3
Texture: sandy loam, fine sandy loam, loam, or loamy sand
Notes: Some pedons do not have a BC horizon.

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 5 to 7, 3 to 6 moist

Chroma: 1 to 4
Texture: sandy loam, fine sandy loam, loam, or loamy fine sand

Lihen Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid
Landform: Terraces and uplands
Parent material: Eolian and alluvium
Slope: 0 to 15 percent

Taxonomic class: Sandy, mixed, frigid Entic Haplustolls

Typical pedon:
Lihen sandy loam, 2,680 feet south and 2,600 feet west of the northeast corner of sec. 14, T. 29 N., R. 53 E. (Colors are for moist soil unless otherwise stated.)

A1—0 to 4 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine platy structure; soft, very friable, nonsticky and nonplastic; many fine roots; many fine and medium tubular pores; 2 percent pebbles; slightly alkaline; clear smooth boundary.

A2—4 to 9 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; massive; slightly hard, very friable, nonsticky and nonplastic; many fine roots; common fine pores and few medium pores; 10 percent pebbles; slightly alkaline; clear smooth boundary.

A3—9 to 24 inches; very dark grayish brown (10YR 3/2) loamy sand, grayish brown (10YR 5/2) dry; single grain; loose, very friable, nonsticky and nonplastic; common fine roots; few pores; 10 percent pebbles; few lime cutans on lower surfaces of pebbles; slight effervescence; moderately alkaline; clear smooth boundary.

Bk—24 to 32 inches; dark grayish brown (2.5Y 4/2) sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; few roots; 10 percent pebbles; common lime cutans on lower surfaces of pebbles; strong effervescence; moderately alkaline; clear smooth boundary.

C—32 to 60 inches; dark grayish brown (2.5Y 4/2) sand, light brownish gray (2.5Y 6/2) dry; single grain; loose, nonsticky and nonplastic; few roots; disseminated lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 12 to 30 inches
Depth to lime: 10 to more than 40 inches

A horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5 dry
Chroma: 2 or 3
Texture: fine sandy loam, sandy loam, loamy fine sand, loamy sand, or sand

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loamy fine sand, loamy sand, fine sand, or sand
Notes: Some pedons do not have a Bk horizon.

C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loamy fine sand, loamy sand, fine sand, or sand

Maddock Series

Depth class: Very deep
Drainage class: Somewhat excessively drained
Permeability: Rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 25 percent

Taxonomic class: Sandy, mixed, frigid Entic Hapludolls

Typical pedon:
Maddock loamy fine sand, 1,220 feet west and 150 feet north of southeast corner of sec. 24, T. 135 N., R. 54 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 10 inches; black (10YR 2/1) loamy fine sand, very dark gray (10YR 3/1) dry; weak fine granular structure parting to single grain; loose; nonsticky and nonplastic; many very fine and few fine roots; neutral; clear wavy boundary.

Bw—10 to 14 inches; dark brown (10YR 3/3) fine sand, brown (10YR 4/3) dry; single grain; loose; nonsticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

C1—14 to 26 inches; dark yellowish brown (10YR 3/4)

fine sand, dark yellowish brown (10YR 4/4) dry; single grain; loose; nonsticky and nonplastic; common very fine roots; neutral; clear wavy boundary.

C2—26 to 43 inches; dark yellowish brownish (10YR 4/4) fine sand, yellowish brown (10YR 5/4) dry; single grain; loose; nonsticky and nonplastic; few very fine roots; slightly alkaline; gradual wavy boundary.

C3—43 to 60 inches; dark yellowish brown (10YR 4/4) fine sand, yellowish brown (10YR 5/4) dry; few fine faint dark yellowish brown (10YR 3/4) redoximorphic concentrations; single grain; loose; nonsticky and nonplastic; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 0 to more than 60 inches
10 to 40 inch particle-size control section: Fine sand, loamy fine sand, loamy sand, or sand
Percent rock fragments: Less than 5 percent

A horizon:
Value: 2 or 3, 3 to 5 dry
Texture: loamy fine sand, fine sandy loam, sandy loam, loam, fine sand, or loamy sand

Bw horizon:
Value: 2 to 5, 4 to 6 dry
Texture: fine sand, loamy fine sand, or loamy sand

C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 7 dry
Chroma: 2 to 4
Texture: fine sand, loamy fine sand, loamy sand, or sand

Makoti Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 9 percent

Taxonomic class: Fine-silty, mixed, superactive, frigid Pachic Haplustolls

Typical pedon:
Makoti silty clay loam, 190 feet east and 70 feet south of the northwest corner, sec. 15, T. 149 N., R. 87 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark brown (10YR 2/2) silty clay loam, dark gray (10YR 4/1) dry; moderate coarse subangular blocky structure parting to moderate medium granular; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; neutral; abrupt smooth boundary.

Bw1—6 to 14 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate fine subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; common very fine and fine pores; slightly acid; clear wavy boundary.

Bw2—14 to 19 inches; very dark grayish brown (2.5Y 3/2) silty clay loam, grayish brown (2.5Y 5/2) dry; moderate coarse prismatic structure parting to moderate fine subangular blocky; slightly hard, firm, slightly sticky and slightly plastic; few fine roots; common very fine and fine pores; neutral; clear wavy boundary.

Bk1—19 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay loam, light brownish gray (2.5Y 6/2) dry; weak medium prismatic structure parting to weak very fine subangular blocky; slightly hard, friable, slightly sticky and nonplastic; few fine roots; common very fine and fine pores; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk2—26 to 34 inches; dark grayish brown (2.5Y 4/2) silt loam, light brownish gray (2.5Y 6/2) dry; weak medium subangular blocky structure parting to weak very fine subangular blocky; slightly hard, friable, slightly sticky and nonplastic; few fine roots; common very fine and fine pores; violent effervescence; slightly alkaline; gradual wavy boundary.

C1—34 to 46 inches; grayish brown (2.5Y 5/2) stratified silt loam and very fine sandy loam, olive yellow (2.5Y 6/6) dry; many medium distinct gray (5Y 5/1) redoximorphic depletions; massive; slightly hard, friable, slightly sticky and nonplastic; few fine roots; common very fine and fine pores; fine rounded masses of lime; strong effervescence; slightly alkaline; gradual smooth boundary.

C2—46 to 60 inches; olive brown (2.5Y 4/4) stratified silty clay loam and very fine sandy loam, light brownish gray (2.5Y 6/2) dry; many medium

distinct grayish brown (2.5Y 5/2) redoximorphic depletions; massive; slightly hard, firm, slightly sticky and slightly plastic; few very fine and fine pores; medium rounded masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 24 inches
Notes: Some pedons do not have a C horizon. Some pedons have a BCk horizon.

Ap horizon:
Hue: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 to 4, 3 to 5 dry

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 or 5, 5 to 7 dry
Chroma: 2 to 4

Marias Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Very slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 15 percent

Taxonomic class: Fine, smectitic, frigid Chromic Haplusterts

Typical pedon:
Marias clay, 2,000 feet west and 120 feet north of the southeast corner of sec. 7, T. 31 N., R. 35 E. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; hard, friable, sticky and very plastic; common fine roots; after a rain a thin weak crust consisting of adhering soil granules forms on the soil surface; slight effervescence; moderately alkaline (pH 7.9); abrupt smooth boundary.

Bw—6 to 11 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong coarse angular blocky structure parting to moderate very fine angular blocky; very hard, firm, sticky and very plastic; common fine roots; common fine tubular pores; dark grayish brown (2.5Y 4/2) organic coatings on faces of peds; slight effervescence; moderately alkaline (pH 8.0); gradual smooth boundary.

Bss—11 to 27 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; strong coarse angular blocky structure parting to moderate very fine angular blocky; very hard, firm, sticky and very plastic; few fine roots; common very fine tubular pores; common slickensides with intersecting surfaces 20 to 40 degrees from horizontal; slight effervescence; moderately alkaline (pH 8.0); clear smooth boundary.

Bssy—27 to 60 inches, gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; moderate very coarse prismatic structure parting to moderate very fine granular; very hard, firm, sticky and very plastic; thick slickensides on faces of prisms; many large (1 inch diameter) masses and threads of gypsum crystals; slight effervescence; moderately alkaline (pH 8.0).

Range in Characteristics

Depth to gypsum or other salts: 20 to 45 inches
Notes: Some pedons have a By horizon.

Ap horizon
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 3 to 5 moist
Chroma: 1 to 3
Notes: It has 27 to 60 percent clay.

Bw horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 5 or 6, 4 or 5 moist
Chroma: 2 or 3
Texture: clay or silty clay
Notes: It has 40 to 60 percent clay.

Bss horizons:
Hue: 10YR, 2.5Y, or 5Y
Value: 5 or 6, 3 to 5 moist
Chroma: 1 to 4
Texture: clay or silty clay
Notes: They have 40 to 60 percent clay.

Marysland Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderate in the upper part and rapid in the lower part
Landform: Outwash plains

Parent material: Glaciofluvial deposits
Slope: 0 to 1 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Calciaquolls

Typical pedon:
Marysland loam, 900 feet east and 200 feet north of the southwest corner, sec. 4, T. 121 N., R. 40 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; very friable; many roots; slight effervescence; moderately alkaline; abrupt wavy boundary.

Ak—9 to 12 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; many roots; disseminated lime; strong effervescence; moderately alkaline; abrupt wavy boundary.

Bkg1—12 to 15 inches; olive gray (5Y 4/2) loam; many fine faint olive gray (5Y 5/2) and dark gray (5Y 4/1) redoximorphic depletions; weak fine subangular blocky structure; very friable; few roots; disseminated lime; strong effervescence; moderately alkaline; clear irregular boundary.

Bkg2—15 to 20 inches; olive gray (5Y 4/2) loam; few fine prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; weak fine and medium subangular blocky structure; very friable; few dark brown (10YR 4/3) coatings in root channels; few small lime masses; strong effervescence; moderately alkaline; clear wavy boundary.

Bkg3—20 to 27 inches; light olive gray (5Y 6/2) loam; few fine prominent olive yellow (2.5Y 6/6) redoximorphic concentrations; weak medium and fine subangular blocky structure; friable; few grayish brown (2.5Y 5/2) root channel fillings; few small lime and dark-colored masses; strong effervescence; moderately alkaline; clear wavy boundary.

2Cg1—27 to 40 inches; grayish brown (2.5Y 5/2) sand; many fine and medium faint light brownish gray (2.5Y 6/2) and common medium prominent yellowish brown (10YR 5/8) redoximorphic concentrations; single grain; loose; slight effervescence; moderately alkaline; gradual wavy boundary.

2Cg2—40 to 60 inches; grayish brown (2.5Y 5/2) sand; many medium faint light brownish gray (2.5Y 6/2) redoximorphic depletions and few medium prominent red (2.5YR 4/8) redoximorphic concentrations; single grain; loose; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 24 inches
Depth to the calcic horizon: 0 to 12 inches
Depth to sand and gravel: 20 to 40 inches

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3
Chroma: 0 or 1

Bkg horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 6, 4 to 7 dry
Chroma: 0 to 2

2Cg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 6, 4 to 8 dry
Notes: It has 1 to 35 percent gravel.

McDonaldsville Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow in the upper part and rapid in the lower part
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 3 percent

Taxonomic class: Clayey over sandy or sandy-skeletal, smectitic, frigid Vertic Endoaquolls

Typical pedon:
McDonaldsville silty clay, 2,340 feet north and 250 feet east of the southwest corner, sec. 36, T. 161 N., R. 56 W. (Colors are for moist soil unless otherwise stated)

Ap—0 to 6 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; weak fine granular structure; extremely hard, firm, very sticky and very plastic; slightly acid; abrupt smooth boundary.

A—6 to 9 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine angular blocky structure; extremely hard, firm, very sticky and very plastic; slightly acid; gradual wavy boundary.

Bw—9 to 23 inches; very dark gray (N 3/0) clay, gray (5Y 5/1) dry; strong fine angular blocky structure; extremely hard, firm, very sticky and very plastic; tongues of A extend into the Bw horizon to depths of 20 inches; slightly acid; diffuse irregular boundary.

BC—23 to 30 inches; olive gray (5Y 4/2) silty clay, olive gray (5Y 5/2) dry; common medium distinct light olive brown (2.5Y 5/4) redoximorphic concentrations; moderate very fine angular blocky structure; very hard, firm, sticky and plastic; some sand grains in cracks and on peds in lower part of horizon; moderately alkaline; clear wavy boundary.

2C1—30 to 36 inches; olive (5Y 4/3) loamy sand, light olive gray (5Y 6/2) dry; many fine prominent light gray (5Y 7/1) and distinct dark gray (5Y 4/1) redoximorphic depletions and dark brown (7.5YR 3/2) redoximorphic concentrations; single grain; slightly hard, slightly sticky and nonplastic; few shale pebbles; few masses of segregated lime; slight effervescence; moderately alkaline; clear smooth boundary.

2C2—36 to 60 inches; olive (5Y 5/3) loamy sand, light gray (5Y 7/2) and pale yellow (5Y 7/3) dry; many fine distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; single grain; few shale pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 15 to 24 inches
Depth to sand: 20 to 40 inches

A horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 or 3, 3 to 5 dry
Notes: It has 35 to 60 percent clay.

Bw horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 or 4, 4 to 6 dry
Chroma: 0 to 3
Texture: clay, silty clay, or clay loam
Notes: It has 35 to 60 percent clay. It is calcareous in some pedons.

2C horizon:
Hue: 5Y or 2.5Y
Value: 3 to 5, 4 to 7 dry
Chroma: 1 to 4
Texture: loamy fine sand, loamy sand, or very fine sand
Notes: Where it has chroma of more than 2, it has low chroma redoximorphic depletions. It has thin strata of sandy loam, very fine sandy loam, or coarse sand in some pedons. It contains up to 15 percent rock fragments in some pedons.

Minnewaukan Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Rapid
Landform: Lake plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent

Taxonomic class: Mixed, frigid Typic Psammaquents

Typical pedon:
Minnewaukan loamy fine sand, 1,055 feet south and 150 feet west of the northeast corner, sec. 17, T. 151 N., R. 63 W. (Colors are for dry soil unless otherwise stated.)

A—0 to 3 inches; dark gray (10YR 4/1), black (10YR 2/1) moist; weak fine subangular blocky and granular structure; soft, very friable, slightly sticky and nonplastic; many roots; about 1 percent gravel; slight effervescence; slightly alkaline; abrupt smooth boundary.

AC—3 to 5 inches; grayish brown (2.5Y 5/2) loamy coarse sand, dark grayish brown and very dark grayish brown (2.5Y 4/2 and 2.5Y 3/2) moist; single grain; nonsticky and nonplastic; many roots; about 15 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

C—5 to 16 inches; light brownish gray (2.5Y 6/2) loamy sand, dark grayish brown with olive brown (2.5Y 4/2 with 2.5Y 4/4) moist; many fine distinct dark yellowish brown (10YR 4/4) moist redoximorphic concentrations; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and nonplastic; few roots; about 1 percent gravel; slight effervescence; slightly alkaline; clear wavy boundary.

Cg1—16 to 28 inches; light gray and light olive gray (5Y 6/1 and 5Y 6/2) loamy sand, olive gray and olive (5Y 4/2 and 5Y 4/3) moist; very weak coarse prismatic structure; slightly sticky and nonplastic; few fine roots; about 10 percent pebbles; about 30 percent of sand and pebbles are shale fragments; few fine masses of lime; slight effervescence; slightly alkaline; clear wavy boundary.

Cg2—28 to 36 inches; light gray (5Y 7/2) fine sand, olive gray and gray (5Y 5/2 and 5Y 5/1) moist; single grain; nonsticky and nonplastic; about 1 percent gravel; slight effervescence; slightly alkaline; clear smooth boundary.

Cg3—36 to 50 inches; brown (10YR 4/3 and 10YR 5/3) fine sand, dark brown (10YR 3/3) moist; single grain; nonsticky and nonplastic; few small iron and manganese concretions; slight effervescence; moderately alkaline.

Cg4—50 to 60 inches; pale olive (5Y 6/3) fine sand, olive (5Y 4/3) moist; single grain; nonsticky and nonplastic; slight effervescence; moderately alkaline.

Range in Characteristics

10 to 40 inch particle-size control section: Loamy fine sand, loamy sand, fine sand, or sand
Notes: Some pedons have horizons that contain 1 to 20 percent gravel.

A and AC horizons:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6
Texture: Ranges from fine sandy loam to sand

C horizon:
Hue: 10YR, 2.5Y, 5Y, or 5GY

Miranda Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Very slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 9 percent
Notes: These soils are saline-sodic.

Taxonomic class: Fine, smectitic, frigid Leptic Natrustolls

Typical pedon:
Miranda loam, 264 feet south and 90 feet west of the northeast corner of sec. 22, T. 124 N., R. 66 W. (Colors are for dry soil unless otherwise stated.)

E—0 to 4 inches; light brownish gray (10YR 6/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to weak thin platy; hard, friable; neutral; abrupt smooth boundary.

Btn1—4 to 7 inches; grayish brown (10YR 5/2) clay loam, very dark brown (10YR 2/2) moist; strong fine and medium columnar structure; extremely hard, very firm, sticky and plastic; light brownish gray (10YR 6/2) coatings on tops of columns; slightly alkaline; abrupt smooth boundary.

Btn2—7 to 10 inches; brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to moderate fine and medium blocky; very hard, very firm, sticky and plastic; moderately alkaline; clear wavy boundary.

Btnz—10 to 16 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak medium subangular; hard, firm, sticky and plastic; common fine accumulations of salts; strongly alkaline; abrupt wavy boundary.

Bkz—16 to 30 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; few fine distinct strong brown (7.5YR 5/8) moist redoximorphic concentrations; weak coarse blocky structure; hard, firm, sticky and plastic; common fine accumulations of salts; common fine accumulations of carbonates; strong effervescence; strongly alkaline; clear smooth boundary.

C1—30 to 38 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine distinct strong brown (7.5YR 5/8) moist redoximorphic concentrations and common medium distinct light gray (10YR 7/1) moist redoximorphic depletions; massive; hard, firm, sticky and plastic; common fine streaks of salt and gypsum; common medium accumulations of carbonates; strong effervescence; strongly alkaline; clear smooth boundary.

C2—38 to 60 inches; pale yellow (2.5Y 7/4) clay loam, light olive brown (2.5Y 5/4) moist; few fine distinct strong brown (7.5YR 5/8) moist redoximorphic concentrations and many fine distinct light gray (10YR 7/1) moist redoximorphic depletions; massive; hard, firm, sticky and plastic; few fine streaks of gypsum; common medium accumulations of carbonates; strong effervescence; strongly alkaline.

Range in Characteristics

Depth to lime: 5 to 25 inches
Depth to gypsum and other salts: 5 to 16 inches
Percent rock fragments: 1 to 10 percent throughout

Notes: Some pedons have A horizons. The combined thickness of the A and E horizons is 5 inches or less.

E horizon:
Hue: 10YR or 2.5Y
Value: 4 to 7, 3 or 4 moist
Chroma: 1 or 2
Texture: loam or silt loam
Notes: The E horizon is absent in some pedons that have an AP horizon.

Btn horizon:
Value: 3 to 6
Chroma: 1 to 4
Texture: clay loam, silty clay, or clay
Notes: They average more than 15 percent fine sand or coarser sand.

Bkz horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 7, 3 to 6 moist

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 8, 3 to 7 moist
Chroma: 1 to 4
Texture: clay loam or loam
Chroma: 1 to 3
Texture: silty clay, clay, or silty clay loam
Notes: They contain nests of gypsum in some pedons.

Cr horizon
Hue: 2.5Y or 5Y
Value: 5 to 7, 3 to 6 moist
Chroma: 2 to 4
Notes: It is laminated in some pedons and massive in others. It commonly has nests or lenses of gypsum.

Niobell Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic, frigid Glossic Natrustolls

Typical pedon:
Niobell loam, 2,215 feet north and 100 feet east of the southwest corner, sec. 25, T. 163 N., R. 97 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many fine pores; about 2 percent gravel; slightly acid; abrupt smooth boundary.

B/E—6 to 9 inches; dark grayish brown (10YR 4/2) (E) and dark brown (10YR 3/3) (B) loam, light brownish gray (10YR 6/2) (E) and brown (10YR 4/3) (B) dry; weak coarse prismatic (B) and moderate medium and fine platy (E) structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine pores; gray (10YR 6/1) dry patches of silt and sand grains on faces of peds; about 2 percent gravel; slightly acid; clear wavy boundary.

Btn1—9 to 13 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; moderate medium prismatic structure parting to moderate medium and fine angular blocky; hard, firm, sticky and plastic; few very fine roots; common fine pores; many distinct very dark grayish brown (10YR 3/2) clay films on faces of peds and lining pores; tops and sides of upper 2 inches of prisms coated with patches of cleaned sand grains; about 2 percent gravel; neutral; gradual wavy boundary.

Btn2—13 to 19 inches; dark grayish brown (10YR 4/2) clay loam, brown (10YR 5/3) dry; moderate medium prismatic structure parting to strong medium and fine angular blocky; very hard, firm, sticky and plastic; few very fine roots; common fine pores; many distinct dark brown (10YR 3/3) clay films on faces of peds and lining pores; about 2 percent gravel; moderately alkaline; clear wavy boundary.

Bky1—19 to 22 inches; olive brown (2.5Y 4/4) loam, light olive brown (2.5Y 5/4) dry; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, sticky and slightly plastic; common medium and fine crystals of gypsum; many large masses of lime; about 2 percent gravel; slight effervescence; moderately alkaline; gradual wavy boundary.

Bky2—22 to 29 inches; olive brown (2.5Y 4/3) loam, light yellowish brown (2.5Y 6/3) dry; weak medium and fine subangular blocky structure; hard, friable, sticky and slightly plastic; many fine crystals of gypsum; about 2 percent gravel; common medium

and fine masses of lime; violent effervescence; strongly alkaline; gradual wavy boundary.

BCky—29 to 44 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/3) dry; massive; very hard, firm, sticky and slightly plastic; common fine crystals of gypsum; about 2 percent gravel; few fine masses of lime; strong effervescence; strongly alkaline; gradual wavy boundary.

C—44 to 60 inches; olive brown (2.5Y 4/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct brown (10YR 5/3) relict redoximorphic concentrations and few fine prominent gray (5Y 5/1) relict redoximorphic depletions; massive; very hard, firm, sticky and slightly plastic; about 2 percent gravel; few small fragments of lignite; few gypsum crystals; few masses of lime; slight effervescence; strongly alkaline.

Range in Characteristics

Depth to lime: 8 to 30 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 2 or 3

B/E horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 4 to 7 dry
Notes: Some cultivated pedons do not have a B/E horizon.

Btn horizon:
Value: 4 to 6 dry
Chroma: 2 to 4

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

BCk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam
Notes: Some pedons do not have a BCk horizon.

Noonan Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Fine, smectitic, frigid Typic Natrustolls

Typical pedon:
Noonan loam, 1,850 feet south and 110 feet west of the northeast corner, sec. 35, T. 163 N., R. 97 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine subangular blocky structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; many fine pores; about 2 percent gravel; neutral; abrupt smooth boundary.

Btn1—6 to 9 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (10YR 4/2) dry; strong coarse and medium columnar structure parting to moderate medium angular blocky; tops of columns capped with gray (10YR 6/1) dry loam; very hard, firm, sticky and plastic; few very fine roots; many distinct very dark brown (10YR 2/2) clay films on faces of peds and lining pores; about 2 percent gravel; strongly alkaline; clear wavy boundary.

Btn2—9 to 12 inches; very dark grayish brown (10YR 3/2) clay loam, dark grayish brown (2.5Y 4/2) dry; moderate coarse prismatic structure parting to strong medium angular blocky; very hard, firm, sticky and plastic; few very fine roots; few pores; faces of peds coated with brown (10YR 4/3) clay films; about 2 percent gravel; strongly alkaline; clear wavy boundary.

Bk—12 to 20 inches; olive brown (2.5Y 4/3) clay loam, light olive brown (2.5Y 5/3) dry; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and slightly plastic; few very fine roots; about 2 percent gravel; few medium masses of lime; few fine nests of gypsum in the lower part; strong effervescence; strongly alkaline; gradual wavy boundary.

Bky—20 to 28 inches; olive brown (2.5Y 4/3) loam, light yellowish brown (2.5Y 6/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, sticky and slightly plastic; few fine and medium roots; about 2 percent gravel; few fine nests of gypsum; common fine masses of lime; strong effervescence; strongly alkaline; gradual boundary.

BCy—28 to 60 inches; olive brown (2.5Y 4/3) loam, light yellowish brown (2.5Y 6/3) and light olive brown (2.5Y 5/3) dry; weak coarse and medium subangular blocky structure; very hard, firm, sticky and slightly plastic; about 2 percent gravel; common medium nests of gypsum; slight effervescence; strongly alkaline.

Range in Characteristics

Depth to gypsum or other salts: More than 16 inches
Notes: Some pedons have an E or C horizon.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Btn horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 6 dry
Chroma: 2 to 4

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

BCy horizon:
Texture: loam or clay loam

Parnell Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Vertic Argiaquolls

Typical pedon:
Parnell silty clay loam, 1,320 feet north and 35 feet west of the southeast corner, sec. 10, T. 125 N., R. 40 W. (Colors are for moist soil unless otherwise stated.)

A1—0 to 15 inches; black (10YR 2/1) silty clay loam, black (10YR 2/1) dry; few fine distinct dark brown (7.5YR 3/2) and few fine prominent reddish brown (5YR 4/4) redoximorphic concentrations; moderate very fine and fine subangular blocky structure; friable; common roots; neutral; clear smooth boundary.

A2—15 to 22 inches; very dark gray (10YR 3/1) silt loam, dark gray (10YR 4/1) dry; moderate fine and medium platy structure parting to weak very fine subangular blocky; friable; few roots; few patchy gray (10YR 6/1) coatings on faces of peds when dry; slightly acid; clear smooth boundary.

Btg1—22 to 32 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to moderate medium subangular blocky; firm; few roots; many thin coatings of clean sand and silt particles on faces of peds; few faint black (10YR 2/1) clay films on faces of peds; slightly acid; gradual smooth boundary.

Btg2—32 to 55 inches; black (10YR 2/1) grading to very dark gray (10YR 3/1) silty clay, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to strong angular blocky; firm; many faint black (10YR 2/1) clay films on faces of peds; slightly acid in upper part grading to neutral in lower part; diffuse wavy boundary.

BCg—55 to 80 inches; grayish brown (2.5Y 5/2) grading to olive gray (5Y 5/2) in the lower part, silty clay loam; common fine prominent reddish brown (5YR 4/4) redoximorphic concentrations and common fine faint dark grayish brown (2.5Y 4/2) redoximorphic depletions; weak very fine angular blocky structure; firm in upper part and friable in lower part; few strata of loam and silty clay; few distinct black (10YR 2/1) and very dark gray (10YR 3/1) clay films in upper part; neutral in upper part becoming slightly alkaline; slight effervescence in lower part.

Range in Characteristics

Mollic epipedon thickness: 24 to more than 60 inches
Depth to lime: 35 to more than 60 inches
Notes: Some pedons have an O or Cg horizon.

A horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 to 5 dry
Chroma: 0 or 1

Btg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4, 3 to 6 dry
Chroma: 1 or 2
Texture: silty clay or silty clay loam

BCg horizon:
Hue: 2.5Y or 5Y
Value: 3 to 5
Chroma: 1 or 2

Parshall Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Terraces and uplands
Parent material: Alluvium
Slope: 0 to 25 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Pachic Haplustolls

Typical pedon:
Parshall fine sandy loam, 1,550 feet north and 950 feet east of southwest corner, sec. 33, T. 139 N., R. 81 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; common very fine and few fine pores; neutral; abrupt smooth boundary.

A—7 to 12 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and very fine and few medium roots; many fine and very fine and few medium pores; neutral; clear wavy boundary.

Bw1—12 to 20 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine and few medium roots; many very fine and fine and few medium pores; slightly alkaline; clear wavy boundary.

Bw2—20 to 29 inches; dark olive brown (2.5Y 3/3) fine sandy loam, light olive brown (2.5Y 5/3) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine and few fine pores; neutral; abrupt smooth boundary.

Bk1—29 to 42 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, grayish brown (2.5Y 5/2) dry; moderate coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; common very fine and few fine roots; many very fine and few fine pores; few fine filaments of lime; strong effervescence; moderately alkaline; clear smooth boundary.

Bk2—42 to 48 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and nonplastic; few fine and very fine roots; common very fine pores; common fine filaments of lime; strong effervescence; moderately alkaline; abrupt wavy boundary.

BCk—48 to 60 inches; olive brown (2.5Y 4/3) loamy fine sand, light yellowish brown (2.5Y 6/3) dry; weak coarse subangular blocky structure; soft, very friable, slightly sticky and nonplastic; few fine and very fine roots; few very fine pores; few fine irregularly shaped masses and common fine filaments of lime; violent effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 40 inches
Notes: Some pedons have an Ab horizon below a depth of 50 inches. Some pedons have a C horizon.

A horizon:
Value: 3 or 4 dry

Bw horizon:
Chroma: 2 to 4

Bk horizon:
Hue: 10YR or 2.5Y
Texture: fine sandy loam or loamy fine sand

Portal Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow in the upper part and moderately rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 6 percent
Notes: These soils are sodic.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Natrustolls

Typical pedon:
Portal fine sandy loam, 900 feet north and 250 feet east of the southwest corner of sec. 29, T. 163 N., R. 95 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; many fine and medium roots; slightly acid; abrupt smooth boundary.

E—6 to 8 inches; pale brown (10YR 6/3) fine sand, dark brown (10YR 4/3) moist; weak medium platy structure parting to weak thin platy; soft, very friable, nonsticky and nonplastic; many fine and medium roots; neutral; abrupt wavy boundary.

Btn—8 to 12 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; moderate coarse columnar structure parting to moderate medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; tops of columns capped with dark grayish brown (10YR 4/2) moist E material; many distinct clay films on faces of peds; few clean sand grains on faces of peds; slightly alkaline; clear wavy boundary.

Btkn—12 to 22 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; common distinct clay films on faces of peds; few clean sand grains on faces of peds; common medium masses of lime in interior of peds; strong effervescence; moderately alkaline; clear wavy boundary.

Bk—22 to 40 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/4) moist; moderate medium angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

BCk—40 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; common medium prominent olive gray (5Y 5/2) moist redoximorphic depletions; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine masses of lime; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Depth to lime: 10 to 28 inches

Ap horizon:
Value: 3 or 4, 2 or 3 moist
Chroma: 2 or 3
Texture: fine sandy loam, sandy loam, or loamy sand

E horizon:
Value: 5 or 6, 4 or 5 moist
Chroma: 2 or 3
Texture: loamy fine sand, fine sand, fine sandy loam, or sandy loam

Bt horizon:
Value: 3 to 5, 2 to 4 moist
Chroma: 2 to 4
Texture: fine sandy loam or sandy loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 7, 4 to 6 moist
Chroma: 1 to 4
Texture: fine sandy loam or sandy loam

BCk horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6, 3 to 5 moist
Chroma: 2 to 4
Texture: fine sandy loam or sandy loam

Reeder Series

Depth class: Moderately deep
Drainage class: Well drained
Permeability: Moderate
Landform: Uplands
Parent material: Soft mudstone and sandstone
Slope: 0 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Argiustolls

Typical pedon:
Reeder loam, 1,575 feet south and 475 feet west of the northeast corner, sec. 14, T. 129 N., R. 100 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak coarse and fine subangular blocky structure

parting to weak fine granular; friable; many roots, many fine pores; neutral; abrupt smooth boundary.

Bt1—8 to 12 inches; dark brown (10YR 3/3) clay loam, brown (10YR 5/3) dry; moderate coarse and medium prismatic and moderate medium angular blocky structure; friable; common roots, many fine pores; many faint clay films on vertical and many clay films on horizontal faces of peds; neutral; clear smooth boundary.

Bt2—12 to 17 inches; dark grayish brown (10YR 4/2) clay loam, brown (10YR 5/3) dry; moderate medium prismatic and moderate medium angular blocky structure; friable; many clay films on faces of peds; neutral; gradual wavy boundary.

Bk1—17 to 32 inches; dark grayish brown (2.5Y 4/3) loam, light brownish gray (2.5Y 6/3) dry; weak coarse and medium prismatic and moderate medium subangular blocky structure; friable; few roots; many fine pores; common masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk2—32 to 36 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; weak medium subangular blocky structure; friable; few fine roots; many fine threads of lime, strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—36 to 60 inches; olive (5Y 5/3) soft sandstone and siltstone, pale yellow (5Y 7/3) dry; few masses of lime; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to soft bedrock: 20 to 40 inches
Notes: Some pedons have a stratified loam, clay loam, or silty clay loam C horizon.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

Bt horizon:
Hue: 7.5YR, 10YR, or 2.5Y
Value: 3 to 5, 4 to 6 dry
Chroma: 2 to 4

Bk horizon:
Notes: Some pedons do not have a Bk horizon.

Regan Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-silty, mixed, superactive, frigid Typic Calciaquolls

Typical pedon:
Regan silty clay loam, 1,650 feet south and 1,000 feet east of the northwest corner, sec. 34, T. 144 N., R. 78 W. (Colors are for moist soil unless otherwise stated.)

A1—0 to 4 inches; very dark gray (2.5Y 3/1) silty clay loam, dark gray (2.5Y 4/1) dry; moderate fine granular structure; hard, friable, slightly sticky and slightly plastic; many roots; slight effervescence; moderately alkaline; clear wavy boundary.

A2—4 to 9 inches; very dark gray (5Y 3/1) silty clay loam, gray (5Y 5/1) dry; strong fine and very fine subangular blocky structure parting to strong fine granular; hard, friable, sticky and slightly plastic; common roots; strong effervescence; moderately alkaline; clear very wavy boundary.

Bkg1—9 to 16 inches; gray (5Y 5/1) silty clay loam, light gray (5Y 6/1) dry; moderate medium granular structure; very hard, friable, sticky and slightly plastic; common roots; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg2—16 to 28 inches; dark gray (5Y 4/1) silty clay loam, gray (5Y 5/1) dry; massive; extremely hard, firm; few roots; violent effervescence; moderately alkaline; gradual wavy boundary.

2Cg1—28 to 54 inches; olive gray (5Y 4/2) clay loam, gray (5Y 5/1) dry; massive; extremely hard, friable; few roots; few pores; few salt crystals; strong effervescence; moderately alkaline; clear smooth boundary.

2Cg2—54 to 60 inches; olive gray (5Y 4/2) sandy clay loam, gray (5Y 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) redoximorphic concentrations; massive, stratified with clay loam and sandy loam layers; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches

A horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 or 3
Chroma: 1 or 2
Texture: silt loam or silty clay loam

Bkg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 6, 4 to 7 dry
Chroma: 1 or 2
Texture: silt loam or silty clay loam

2Cg horizon:
Value: 3 to 5, 5 to 7 dry
Chroma: 1 to 4

Roseglen Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 9 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Pachic Haplustolls

Typical pedon:
Roseglen silt loam, 2,525 feet east and 1,990 feet north of the southwest corner, sec. 29, T. 139 N., R. 78 W. (Colors are for dry soil unless otherwise stated)

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; soft, very friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

Bw1—7 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and fine prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; irregular wavy boundary.

Bw2—14 to 21 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse and medium prismatic structure parting to weak medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; neutral; clear wavy boundary.

Bw3—21 to 24 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; moderate coarse and medium prismatic structure parting to weak medium angular blocky; slightly hard, friable, slightly sticky and slightly plastic; slightly alkaline; gradual wavy boundary.

Bk—24 to 34 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure parting to weak medium angular blocky; hard, firm, sticky and plastic; many masses of lime; violent effervescence; moderately alkaline; gradual irregular boundary.

C1—34 to 53 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse prismatic structure; hard, firm, slightly sticky and slightly plastic; strong effervescence; slightly alkaline; abrupt irregular boundary.

C2—53 to 60 inches; laminated very pale brown (10YR 8/4) silt loam, dark grayish brown (10YR 4/2) moist; few large distinct light gray (10YR 7/1) redoximorphic depletions and few medium prominent reddish yellow (7.5YR 6/8) redoximorphic concentrations; massive; slightly hard, firm, slightly sticky and slightly plastic; many fine pores; few masses of lime; strong effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 36 inches
Depth to lime: 15 to 30 inches

Ap horizon:
Value: 3 to 5, 2 or 3 moist

Bw horizon:
Value: 3 to 5
Texture: silt loam or loam

Bk horizon:
Hue: 10YR or 2.5Y
Value: 6 or 7, 4 or 5 moist
Chroma: 1 to 3
Texture: silt loam or loam

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6 moist
Chroma: 1 to 4
Texture: silt loam or loam

Sakakawea Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 6 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-silty, mixed, superactive, frigid Typic Calciustolls

Typical pedon:
Sakakawea loam, 2,425 feet west and 1,500 feet south of the northeast corner, sec. 23, T. 158 N., R. 93 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bk1—6 to 14 inches; brown (10YR 5/3) silt loam, very pale brown (10YR 7/3) dry; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and plastic; few very fine roots; many fine irregular masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

Bk2—14 to 21 inches; olive brown (2.5Y 4/4) silt loam, light yellowish brown (2.5Y 6/4) dry; hard, friable, slightly sticky and plastic; few very fine roots; few fine irregular masses of lime; violent effervescence; moderately alkaline; clear smooth boundary.

C1—21 to 29 inches; stratified grayish brown (2.5Y 5/2) and olive brown (2.5Y 4/4) silt loam, light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/4) dry; few fine prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; massive; slightly hard, friable, slightly sticky and plastic; few very fine roots; few fine filaments of lime; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—29 to 41 inches; stratified grayish brown (2.5Y 5/2) and light olive brown (2.5Y 5/4) loam, light brownish gray (2.5Y 6/2) and pale yellow (2.5Y 7/4) dry; few fine prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline; abrupt smooth boundary.

C3—41 to 60 inches; stratified grayish brown (2.5Y 5/2) silty clay loam and light yellowish brown (2.5Y 6/4) loamy sand, light brownish gray (2.5Y 6/2) and pale yellow (2.5Y 7/4) dry; few fine prominent strong brown (7.5YR 5/6) relict redoximorphic concentrations; massive; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches
Depth to lime: 0 to 7 inches

Ap horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 to 3
Texture: loam, clay loam, silt loam, or silty clay loam

Bk horizon:
Value: 4 to 6, 5 to 8 dry
Chroma: 2 to 4

C horizon:
Value: 5 to 8 dry
Texture: loam or silt loam in the upper part and silty clay, silty clay loam, silt loam, loam, very fine sandy loam, fine sandy loam, loamy sand, or loamy fine sand in distinct layers in the lower part

Seroco Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Rapid
Landform: Uplands
Parent material: Eolian material
Slope: 0 to 35 percent

Taxonomic class: Mixed, frigid Typic Ustipsamments

Typical pedon:
Seroco loamy fine sand, 1,056 feet south and 60 feet east of the northwest corner, sec. 13, T. T. 144 N., R. 86 W. (Colors are for dry soil unless otherwise stated.)

A—0 to 3 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark brown (10YR 3/2) moist; weak medium subangular blocky structure; loose; many fine roots; slightly acid; gradual wavy boundary.

C1—3 to 20 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; single grain; common fine roots; neutral; gradual wavy boundary.

C2—20 to 60 inches; brown (10YR 5/3) fine sand, brown (10YR 4/3) moist; single grain; few roots; neutral.

Range in Characteristics

Notes: Some pedons have an AC horizon.

A horizon:
Value: 4 to 6, 3 or 4 moist
Chroma: 2 or 3

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 4

Southam Series

Depth class: Very deep
Drainage class: Very poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Fine, smectitic, calcareous, frigid Cumulic Vertic Endoaquolls

Typical pedon:
Southam silty clay loam, 2,450 feet north and 1,050 feet west of the southeast corner, sec. 6, T. 153 N., R. 61 W. (Colors are for moist soil unless otherwise stated.)

Ag1—0 to 16 inches; black (5Y 2/1) silty clay loam, dark gray (5Y 4/1) dry; massive; firm, sticky and plastic; common fine snail shell fragments; strong effervescence; slightly alkaline; gradual wavy boundary.

Ag2—16 to 26 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; few fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; firm, sticky and plastic; common fine snail shell fragments; strong effervescence; slightly alkaline; gradual wavy boundary.

Ag3—26 to 32 inches; black (5Y 2/1) silty clay, dark gray (5Y 4/1) dry; few fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; very firm, very sticky and very plastic; common fine snail shell fragments; common fine concentrations of gypsum in nests and along planes; strong effervescence; moderately alkaline; gradual wavy boundary.

Ag4—32 to 40 inches; black (5Y 2/1 and 5Y 2/2) silty clay, dark gray (5Y 4/1) and olive gray (5Y 4/2) dry; few fine prominent olive brown (2.5Y 4/4) redoximorphic concentrations; massive; very firm, very sticky and very plastic; common fine snail shell fragments; common fine concentrations of gypsum in nests and along planes; slight effervescence; moderately alkaline; gradual wavy boundary.

Cg1—40 to 48 inches; very dark grayish brown (2.5Y 3/2) and dark grayish brown (2.5Y 4/2) silty clay, grayish brown (2.5Y 5/2) and light brownish gray (2.5Y 6/2) dry; few fine prominent yellowish red (5YR 4/6) and few fine distinct olive brown (2.5Y 4/4) redoximorphic concentrations; massive; very firm, very sticky and very plastic; few fine rounded manganese concretions; common fine snail shell fragments; common fine concentrations of gypsum in nests and along planes; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg2—48 to 54 inches; grayish brown (2.5Y 5/2) silty clay, light brownish gray (2.5Y 6/2) dry; many fine and medium distinct olive brown (2.5Y 4/4) and few medium prominent yellowish red (5YR 4/6) redoximorphic concentrations; few medium prominent threadlike light gray (N 7/0) redoximorphic depletions; massive; very firm, very sticky and very plastic; common fine snail shell fragments; common fine rounded manganese concretions; common fine concentrations of gypsum in nests and along planes; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg3—54 to 60 inches; dark grayish brown (2.5Y 4/2) and light gray (N 7/0) silty clay, light gray (2.5Y 7/2) and white (2.5Y 8/2) dry; common medium prominent strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6) redoximorphic concentrations; massive; very firm, very sticky and very plastic; few fine rounded manganese concretions; common fine snail shell fragments; common fine concentrations of gypsum in nests and along planes; strong effervescence; moderately alkaline.

Range in Characteristics

Thickness of mollic epipedon: 24 to more than 60 inches
Depth to lime: 0 to 10 inches
Notes: Some pedons have an O horizon up to 4 inches thick. Some pedons have a 2C horizon at a depth of 40 to 60 inches.

Ag horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Chroma: 0 to 2

Cg horizon:
Hue: 2.5Y, 5Y, or neutral
Value: 3 to 6, 5 to 8 dry
Texture: clay loam, silty clay, or silty clay loam

Stady Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate in the upper part and very rapid in the lower part
Landform: Terraces
Parent material: Alluvium over glaciofluvial deposits
Slope: 0 to 9 percent

Taxonomic class: Fine-loamy over sandy or sandy-skeletal, mixed, superactive, frigid Typic Haplustolls

Typical pedon:
Stady loam, 220 feet north and 115 feet east of the southwest corner, sec. 35, T. 133 N., R. 100 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; friable; many roots and very fine pores; neutral; abrupt smooth boundary.

Bw1—6 to 12 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; strong coarse prismatic and moderate medium subangular blocky structure; friable; common roots; common very fine pores; faint clay films on prism faces; neutral; gradual smooth boundary.

Bw2—12 to 15 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate coarse prismatic structure; friable; few roots; common very fine pores; neutral; clear wavy boundary.

Bk1—15 to 18 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic and moderate coarse and medium subangular blocky structure; friable; few roots; disseminated lime throughout; strong effervescence; slightly alkaline; clear wavy boundary.

Bk2—18 to 29 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic and subangular blocky structure; friable; few roots; few stones; common masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

2Bk3—29 to 42 inches; light brownish gray (2.5Y 6/2) sand and gravel, grayish brown (2.5Y 5/2) moist; single grain; loose; thin lime crusts coat bottom of all pebbles; violent effervescence; moderately alkaline, gradual boundary.

2C—42 to 60 inches; light yellowish brown (10YR 6/4) sand and gravel, dark yellowish brown (10YR 4/4) moist; single grain; loose; strong effervescence; moderately alkaline.

Range in Characteristics

Depth to lime: 15 to 25 inches
Depth to sand and gravel: 20 to 40 inches

Ap horizon:
Value: 3 to 5, 2 or 3 moist
Texture: loam or silt loam

Bw horizon:
Value: 4 to 6, 2 to 4 moist
Chroma: 2 to 4

Bk horizon:
Hue: 10YR or 2.5Y
Value: 6 or 7, 4 or 5 moist
Chroma: 2 to 4

2Bk and 2C horizons:
Value: 5 or 6

Stirum Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow in the upper part and rapid in the lower part
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are saline-sodic.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Natraquolls

Typical pedon:
Stirum fine sandy loam, 2,290 feet south and 240 feet east of the northwest corner, sec. 24, T. 138 N., R. 54 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

Btn—7 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, gray (10YR 5/1) dry; strong coarse columnar structure parting to moderate fine and medium angular blocky; very hard, firm, slightly sticky and plastic; very dark grayish brown (10YR 3/2) clay films on faces of peds; slight effervescence; strongly alkaline; wavy boundary.

Bk—15 to 26 inches; light brownish gray (2.5Y 6/2) loam, light gray (2.5Y 7/2) dry; common fine prominent yellowish brown (10YR 5/4) redoximorphic concentrations; strong very coarse prismatic structure parting to weak fine and medium angular blocky; very hard, firm, plastic; strong effervescence; very strongly alkaline; gradual boundary.

Bg—26 to 34 inches; olive gray (5Y 5/2) very fine sandy loam, light gray (5Y 7/2) dry; common medium prominent yellowish brown (10YR 5/4) and many medium very dark grayish brown (10YR 3/2) redoximorphic concentrations; weak subangular blocky structure; very friable, slightly sticky; slight effervescence; strongly alkaline; clear wavy boundary.

Bkg—34 to 44 inches; light olive gray (5Y 6/2) silt loam, light gray (5Y 7/2) dry; many medium prominent dark brown (7.5YR 4/4) and many coarse very dark grayish brown (10YR 3/2) redoximorphic concentrations; weak fine angular blocky structure; slightly plastic; strong effervescence; strongly alkaline; clear wavy boundary.

2Cg—44 to 60 inches; gray (5Y 5/1) loamy fine sand, light gray (5Y 7/1) dry; many medium prominent dark yellowish brown (10YR 4/4) and few very dark grayish brown (10YR 3/2) redoximorphic concentrations; single grain; strongly alkaline.

Range in Characteristics

Thickness of mollic epipedon: 7 to 24 inches
Depth to lime: 0 to 10 inches
Notes: Some pedons have an E or C horizon.

Ap horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 0 to 2

Btn horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 6, 4 to 8 dry
Chroma: 0 to 2
Texture: fine sandy loam, sandy loam, or loam
Notes: It has salt crystals in some pedons

Bk horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 4 to 7, 5 to 8 dry
Chroma: 0 to 4
Texture: sandy clay loam to loamy fine sand
Notes: Some pedons do not have a Bk horizon. Some pedons have a BCk horizon.

2Cg horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 3 to 7, 5 to 8 dry
Chroma: 0 to 6
Texture: silt loam to fine sand
Notes: Some pedons have strata of textures finer than silt loam. Some pedons have sand below 30 inches. Some pedons do not have a 2Cg horizon.

Straw Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderate
Landform: Flood plains and alluvial flats
Parent material: Alluvium
Slope: 0 to 8 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Cumulic Haplustolls (fig. 12)

Typical pedon:
Straw loam, 500 feet south and 100 feet west of the northeast corner of the southeast 1/4 of sec. 25, T. 18 N., R. 6 E. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist;

Figure 12. Typical profile of Straw loam.

moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and few medium roots; many fine and medium pores; disseminated lime; slight effervescence; slightly alkaline (pH 7.6); clear wavy boundary.

A2—10 to 27 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine pores; disseminated lime; strong effervescence; moderately alkaline (pH 8.0); diffuse boundary.

Bk—27 to 38 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure; hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; many fine and very fine pores; disseminated lime; few fine masses of lime; strong effervescence; moderately alkaline (pH 8.0); gradual wavy boundary.

C1—38 to 54 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; common fine and very fine pores; disseminated lime; strong effervescence; moderately alkaline (pH 8.3); clear smooth boundary.

2C2—54 to 66 inches; light brownish gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; strong effervescence; slightly alkaline (pH 7.6).

Range in Characteristics

Mollic epipedon thickness: 16 to 40 inches
Depth to the Bk horizon: 13 to 30 inches
Notes: The soil may be noncalcareous to a depth of 25 inches. Some pedons have Bw or Ab horizons. This soil has a range of 0 to 10 percent gravel.

Ap and A horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 2 or 3 moist
Chroma: 2 or 3
Texture: loam, clay loam, silt loam, sandy clay loam, or silty clay loam
Notes: This horizon has less than 15 to 35 percent fine and coarser sand.

Bk horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 3 to 5 moist
Chroma: 2 to 4
Texture: loam, silt loam, silty clay loam, clay loam
Notes: This horizon has less than 15 to 35 percent fine and coarser sand.

C horizon:
Hue: 10YR or 2.5Y
Value: 5 or 6, 4 or 5 moist
Chroma: 2 to 4
Texture: loam, silt loam, or clay loam stratified with sandy loam or fine sandy loam

2C horizon:
Hue: 10YR or 2.5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 2 to 4
Texture: stratified loam to loamy sand but mainly sandy loam or loamy sand

Svea Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 1 to 6 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Pachic Hapludolls

Typical pedon:
Svea loam, 500 feet north and 10 feet east of the southwest corner of sec. 19, T. 136 N., R. 59 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; neutral; abrupt smooth boundary.

A—7 to 10 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse prismatic structure parting to moderate medium granular; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; common fine pores; neutral; clear wavy boundary.

Bw—10 to 21 inches; very dark grayish brown (2.5Y 3/2) loam, dark grayish brown (2.5Y 4/2) dry; moderate medium prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; faint patches of clay films on vertical faces of peds; common fine roots; common fine pores; neutral; clear wavy boundary.

Bk—21 to 36 inches; light olive brown (2.5Y 5/4) clay loam, pale yellow (2.5Y 7/4) dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few fine roots; common fine pores; few medium masses of lime; strong effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; light olive brown (2.5Y 5/4) loam, light yellowish brown (2.5Y 6/4) dry; few fine distinct yellowish red (5YR 4/6) dry redoximorphic concentrations and few fine faint gray (5Y 5/1) dry redoximorphic depletions increasing to common coarse distinct redoximorphic features at a depth of about 42 inches; massive, breaks with slight pressure into weak subangular blocky and platy fragments characteristic of till; hard, friable, slightly sticky and slightly plastic; few masses of lime; slight effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Notes: Some pedons have a BCk horizon.

A horizon:
Value: 2 or 3, 3 or 4 dry

Bw horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 to 3

Bk horizon:
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4

C horizon:
Notes: Some pedons do not have a C horizon.

Swenoda Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid over moderate
Landform: Till plains
Parent material: Glaciolacustrine deposits over glacial till
Slope: 0 to 9 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Pachic Hapludolls

Typical pedon:
Swenoda fine sandy loam, 330 feet west and 100 feet north of the southeast corner of sec. 33, T. 128 N., R. 58 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; soft, very friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; very weak coarse subangular blocky structure parting to weak fine and medium granular; soft, very friable; neutral; gradual smooth boundary.

Bw1—15 to 22 inches; very dark brown (10YR 2/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak medium prismatic structure parting to weak coarse and very coarse subangular blocky; soft,

very friable; slightly alkaline; gradual smooth boundary.

Bw2—22 to 29 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; common fine prominent reddish brown (5YR 5/4) dry redoximorphic concentrations; weak medium prismatic structure parting to weak coarse and very coarse subangular blocky; soft, very friable; slightly alkaline; abrupt wavy boundary.

2Bk—29 to 36 inches; grayish brown (2.5Y 5/2) silt loam, light gray (2.5Y 7/2) dry; common fine prominent reddish brown (5YR 5/4) dry redoximorphic concentrations; weak coarse subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; disseminated lime throughout; violent effervescence; moderately alkaline; clear smooth boundary.

2C—36 to 60 inches; light olive brown (2.5Y 5/4) silt loam, pale yellow (2.5Y 7/4) dry; common fine distinct gray (5Y 5/1) dry redoximorphic depletions and reddish brown (5YR 5/4) dry redoximorphic concentrations; massive; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: More than 16 inches
Depth to lime: 20 and 40 inches
Depth to glacial till: 20 and 40 inches

A horizon:
Hue: 2 or 3, 2 to 4 dry
Texture: fine sandy loam, sandy loam, or loam

Bw horizon:
Hue: 10YR or 2.5Y
Value: 2 to 4, 3 to 6 dry
Chroma: 1 to 4
Texture: fine sandy loam or sandy loam

2Bk horizon:
Hue: 2.5Y or 5Y
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 6
Texture: silt loam, silty clay loam, loam, or clay loam

2C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 6 to 8 dry
Chroma: 2 to 6
Texture: silt loam, silty clay loam, loam, or clay loam

Tally Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Terraces and uplands
Parent material: Alluvium and eolian
Slope: 0 to 9 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Haplustolls

Typical pedon:
Tally sandy loam, 1,200 feet east and 2,000 feet south of the northwest corner of sec. 7, T. 20 N., R. 56 E. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark brown (10YR 2/2) sandy loam, dark brown (10YR 3/3) dry; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; abrupt smooth boundary.

Bw1—6 to 14 inches; very dark brown (10YR 2/2) sandy loam, dark brown (10YR 3/3) dry; moderate medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; common fine and very fine roots; many fine and very fine pores; neutral; clear smooth boundary.

Bw2—14 to 32 inches; dark brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and nonplastic; common fine and very fine roots; many fine and very fine pores; neutral; clear smooth boundary.

Bk1—32 to 38 inches; dark brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; common very fine pores; disseminated lime; strong effervescence; moderately alkaline; clear smooth boundary.

Bk2—38 to 60 inches; light olive brown (2.5Y 5/4) sandy loam, light yellowish brown (2.5Y 6/4) dry; massive; slightly hard, friable, slightly sticky and nonplastic; few very fine roots; common very fine pores; disseminated lime; violent effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 15 to 30 inches
Percent rock fragments: Up to 15 percent above 40 inches and up to 25 percent below 40 inches
Depth to the Bk horizon: 15 to 35 inches
Depth to loamy fine sand and coarser material: More than 20 inches
Notes: Some pedons have a C horizon.

Ap horizon:
Hue: 7.5YR, 10YR, or 2.5Y
Value: 2 to 4, 3 to 5 dry
Texture: fine sandy loam, sandy loam, or loam

Bw horizon:
Hue: 7.5YR, 10YR, or 2.5Y
Chroma: 2 to 4
Texture: fine sandy loam or sandy loam

Bk horizon:
Hue: 7.5YR, 10YR, or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: fine sandy loam or sandy loam
Notes: It has a calcium carbonate equivalent of 5 to 15 percent. It has textures of loamy fine sand, loamy sand, or fine sand below a depth of 40 inches in some pedons.

Tiffany Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Typic Endoaquolls

Typical pedon:
Tiffany fine sandy loam, 550 feet south and 330 feet east of the northwest corner of sec. 23, T. 151 N., R. 54 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 10 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; moderate medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and nonplastic; common very fine roots throughout; many fine pores; slightly acid; abrupt smooth boundary.

A—10 to 15 inches; very dark gray (10YR 3/1) fine sandy loam, dark gray (10YR 4/1) dry; many fine distinct brown (10YR 4/3) redoximorphic concentrations; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots throughout; common medium pores; clear wavy boundary.

AC—15 to 23 inches; dark grayish brown (2.5Y 4/2) fine sandy loam, light brownish gray (2.5Y 6/2) dry; many medium prominent dark yellowish brown (10YR 4/4) redoximorphic concentrations; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots throughout; common fine pores; few fine iron-manganese concretions; clear wavy boundary.

C1—23 to 36 inches; olive brown (2.5Y 4/4) fine sandy loam, light yellowish brown (2.5Y 6/3) dry; many medium prominent strong brown (7.5YR 5/6) and few fine distinct dark gray (10YR 4/1) redoximorphic concentrations; weak medium subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and nonplastic; few very fine roots throughout; common fine pores; slight effervescence (HCl, unspecified); few fine black iron-manganese concretions; clear wavy boundary.

C2—36 to 60 inches; light olive brown (2.5Y 5/4) and light brownish gray (2.5Y 6/2) stratified fine sandy loam, loamy fine sand and loamy very fine sand, pale yellow (2.5Y 7/4) and light gray (2.5Y 7/2) dry; many fine and medium prominent red (2.5YR 5/6), yellowish brown (10YR 5/6) and very dark brown (10YR 2/2) redoximorphic concentrations and olive gray (5Y 5/2) redoximorphic depletions; massive; slightly hard, very friable, nonsticky and nonplastic; slight effervescence throughout (HCl, unspecified); few fine iron-manganese concretions.

Range in Characteristics

Mollic epipedon thickness: 10 to 24 inches
Depth to lime: 20 to more than 60 inches
10 to 40 inch particle-size control section: Averages fine sandy loam to silt loam
Notes: Some pedons have a Bw or Bk horizon. Some pedons have loamy, silty or clayey materials below a depth of 40 inches.

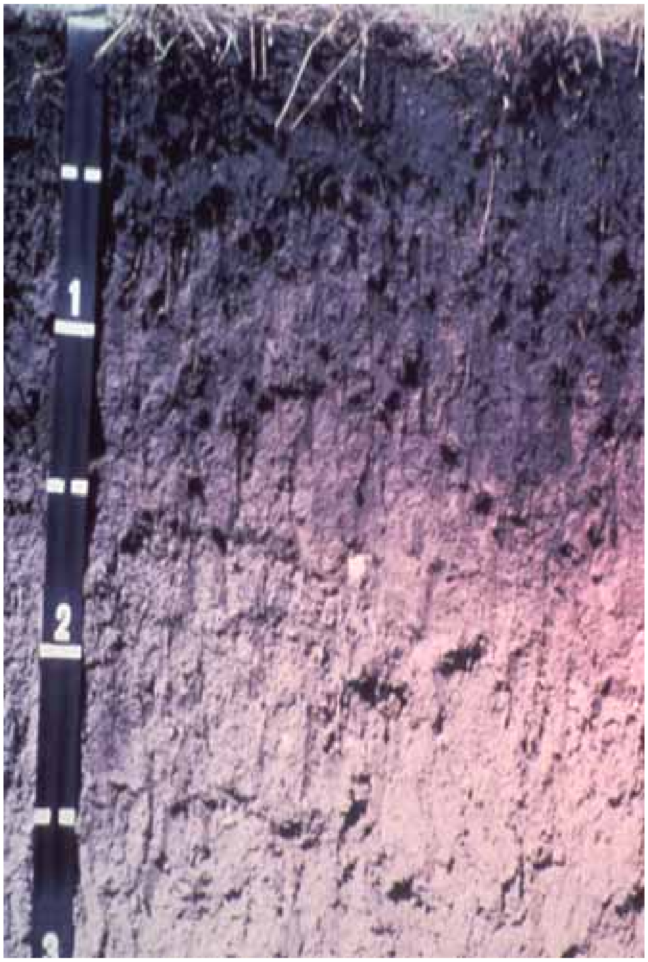

Figure 13. Typical profile of Tonka silt loam.

A horizon:
Texture: fine sandy loam, sandy loam, loam, very fine sandy loam, or silt loam

AC horizon:
Notes: The horizon has redoximorphic features and they increase in number and distinctness with depth.

Tonka Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Slow
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Argiaquic Argialbolls (fig. 13)

Typical pedon:
Tonka silt loam, 2,500 feet west and 590 feet south of the northeast corner, sec. 2, T. 136 N., R. 56 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 13 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine granular structure parting to moderate thin platy; soft, friable, slightly sticky and slightly plastic; many fine roots; many fine pores; slightly acid; abrupt wavy boundary.

E—13 to 19 inches; dark gray (10YR 4/1) loam, light gray (10YR 7/1) dry; many medium prominent dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4) redoximorphic concentrations; moderate thin platy and moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; moderately acid; abrupt irregular boundary.

Bt1—19 to 24 inches; very dark gray (10YR 3/1) silty clay loam, grayish brown (10YR 5/2) dry; common fine faint brown (10YR 4/3) redoximorphic concentrations; strong coarse prismatic structure parting to moderate very fine angular blocky; very hard, firm, sticky and slightly plastic; common fine roots; bleached sand grains coat tops of prisms and vertical faces of peds; moderately acid; gradual wavy boundary.

Bt2—24 to 34 inches; dark grayish brown (10YR 4/2) silty clay loam, light brownish gray (10YR 6/2) dry; moderate coarse prismatic structure parting to moderate very fine angular blocky; very hard, firm, sticky and slightly plastic; common fine roots; bleached sand grains coat faces of peds; moderately acid; gradual wavy boundary.

2BC—34 to 50 inches; dark grayish brown (2.5Y 4/2) clay loam, light brownish gray (2.5Y 6/2) dry; common medium distinct dark yellowish brown (10YR 3/4) redoximorphic concentrations; weak coarse prismatic structure parting to moderate fine subangular blocky; very hard, firm, sticky and slightly plastic; few fine roots; common fine very dark brown (10YR 2/2) manganese concretions; about 2 percent gravel; neutral; gradual boundary.

2Cg—50 to 60 inches; gray (5Y 5/1) clay loam, light gray (5Y 6/1) dry; many medium distinct dark brown (7.5YR 4/4) redoximorphic concentrations; weak fine platy and moderate very fine angular blocky structure; hard, friable, sticky and slightly plastic; few fine roots; common fine very dark brown (10YR 2/2) manganese concretions; about

3 percent gravel; strong effervescence; slightly alkaline.

Range in Characteristics

Depth to lime: 20 to more than 60 inches
Depth to the Bt horizon: 12 to 28 inches
Notes: Some pedons have Bk horizon.

A horizon:
Hue: 10YR or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 0 or 1
Texture: silt loam, loam, clay loam, or silty clay loam

E horizon:
Hue: 10YR, 2.5Y, or neutral
Value: 3 to 5, 5 to 7 dry
Chroma: 0 to 2
Texture: loam, silt loam, very fine sandy loam, or silty clay loam

Bt horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4
Texture: clay loam, silty clay loam, silty clay, or clay

2Cg horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 6, 3 to 7 dry
Chroma: 1 to 6
Texture: silty clay loam, clay loam, or loam

Towner Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Rapid or moderately rapid over moderate or moderately slow
Landform: Lake plains and till plains
Parent material: Eolian over glacial till
Slope: 0 to 6 percent

Taxonomic class: Sandy over loamy, mixed, superactive, frigid Calcic Hapludolls

Typical pedon:
Towner loamy fine sand, 552 feet west and 530 feet south of the northeast corner of sec. 5, T. 153 N., R. 74 W. (Colors are for moist soil unless otherwise stated.)

A1—0 to 6 inches; black (10YR 2/1), broken face, loamy fine sand, dark gray (10YR 4/1), broken face, dry; weak fine granular structure; soft, very friable, nonsticky and nonplastic; many fine roots throughout; neutral; clear wavy boundary.

A2—6 to 20 inches; black (10YR 2/1), broken face, loamy fine sand, dark gray (10YR 4/1), broken face, dry; weak very coarse prismatic structure parting to weak medium subangular blocky and weak coarse subangular blocky; soft, very friable, nonsticky and nonplastic; common fine roots throughout; slightly alkaline; clear wavy boundary.

Bw—20 to 29 inches; very dark grayish brown (10YR 3/2), broken face, loamy fine sand, grayish brown (10YR 5/2), broken face, dry; weak medium and coarse subangular blocky structure; soft, very friable, nonsticky and nonplastic; common fine roots throughout; slightly alkaline; abrupt wavy boundary.

2Bk—29 to 36 inches; grayish brown (2.5Y 5/2), broken face, loam, light gray (2.5Y 7/2), broken face, dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

2C—36 to 60 inches; olive brown (2.5Y 4/4), broken face, loam, light brownish gray (2.5Y 6/2), broken face, dry; weak medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 30 inches
Depth to the glacial till: 20 to 40 inches

2Bk and 2C horizons:
Texture: loam or clay loam

Trembles Series

Depth class: Very deep
Drainage class: Moderately well drained
Permeability: Moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 1 percent
Notes: These soils are calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, calcareous, frigid Typic Ustifluvents

Typical pedon:
Trembles loam, 1,480 feet south and 1,320 feet east of the northwest corner, sec. 8, T. 23 N., R. 60 E. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 9 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse subangular blocky structure parting to moderate coarse granular; hard, friable, slightly sticky and slightly plastic; common very fine roots throughout; very slight effervescence throughout (HCl, 1 normal); slightly alkaline; abrupt smooth boundary.

C1—9 to 15 inches; light yellowish brown (2.5Y 6/3) stratified fine sandy loam, olive brown (2.5Y 4/3) moist; massive; slightly hard, very friable, nonsticky and nonplastic; stratification are 1 to 2 mm thick; few very fine roots throughout; common fine irregular dark yellowish brown (10YR 4/6) iron concretions pedogenic throughout; slight effervescence throughout (HCl, 1 normal); slightly alkaline; clear smooth boundary.

C2—15 to 23 inches; light brownish gray (2.5Y 6/2) stratified silt loam, very fine sandy loam and loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; stratification are 1 to 2 mm thick; few very fine roots throughout; common medium irregular strong brown (7.5YR 4/6) iron concretions pedogenic throughout; few fine irregular masses of lime pedogenic throughout; strong effervescence throughout (HCl, 1 normal); moderately alkaline; clear smooth boundary.

C3—23 to 27 inches; light yellowish brown (2.5Y 6/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; massive; soft, very friable, nonsticky and nonplastic; stratification are 1 to 2 mm thick; few very fine roots throughout; many fine irregular dark yellowish brown (10YR 4/6) iron concretions pedogenic throughout; strata of organic matter or coal 1 mm thick throughout; strong effervescence throughout (HCl, 1 normal); moderately alkaline; clear smooth boundary.

C4—27 to 48 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, nonsticky and nonplastic; stratification are 1 to 2 mm thick; few very fine roots throughout; strata of organic matter or coal 1 mm thick throughout; slight effervescence throughout(HCl, 1 normal); moderately alkaline; clear smooth boundary.

C5—48 to 59 inches; light brownish gray (2.5Y 6/2) stratified very fine sandy loam, silt loam, and fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; stratification are 1 to 2 mm thick; strong effervescence throughout; moderately alkaline; clear smooth boundary.

2C6—59 to 63 inches; light brownish gray (2.5Y 6/2) stratified sand, grayish brown (2.5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; stratification are 1 to 2 mm thick; common fine irregular dark yellowish brown (10YR 4/6) iron concretions pedogenic throughout; slight effervescence throughout (HCl, 1 normal); strata of organic matter or coal 1 mm thick throughout; moderately alkaline; clear smooth boundary.

2C7—63 to 80 inches; light brownish gray (2.5Y 6/2) sand, grayish brown (2.5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; common fine irregular dark yellowish brown (10YR 4/6) iron concretions pedogenic throughout; strata of coal 1 mm thick throughout; slight effervescence throughout (HCl, 1 normal); moderately alkaline.

Range in Characteristics

Ap horizon:
Hue: 10YR or 2.5Y
Texture: fine sandy loam or loam

C horizon:
Hue: 2.5Y or 10YR
Texture: fine sandy loam, very fine sandy loam, sandy loam, loam, or silt loam

Ustorthents

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains and moraines
Parent material: Glacial till and residuum
Slope: 0 to 35 percent

Taxonomic class: Ustorthents

Typical pedon:
Ustorthents loam, 975 feet north and 850 feet west of the southeast corner, sec. 18, T. 162 N., R. 94 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to moderate fine subangular blocky; soft, friable, slightly sticky and slightly plastic; common fine and very fine and few medium roots; about 5 percent gravel; strong effervescence; slightly alkaline; clear wavy boundary.

C1—4 to 19 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; slightly hard, firm, sticky and plastic; common fine and very fine roots; common lignite chips; about 10 percent gravel; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—19 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; few very fine roots; common lignite chips; about 10 percent gravel; violent effervescence; moderately alkaline.

Range in Characteristics

Depth to lime: 0 to 6 inches

A horizon:
Hue: 10YR to 5Y
Value: 3 to 7, 4 to 6 moist
Chroma: 1 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR to 5Y
Value: 5 to 7, 4 to 6 moist
Chroma: 1 to 6
Texture: loam, clay loam, or sandy clay loam

Vallers Series

Depth class: Very deep
Drainage class: Poorly drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 1 percent
Notes: These soils are highly calcareous and saline.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciaquolls

Typical pedon:
Vallers loam, 800 feet west and 150 feet north of the southeast corner of sec. 6, T. 156 N., R. 67 W. (Colors are for moist soil unless otherwise stated.) (fig. 14)

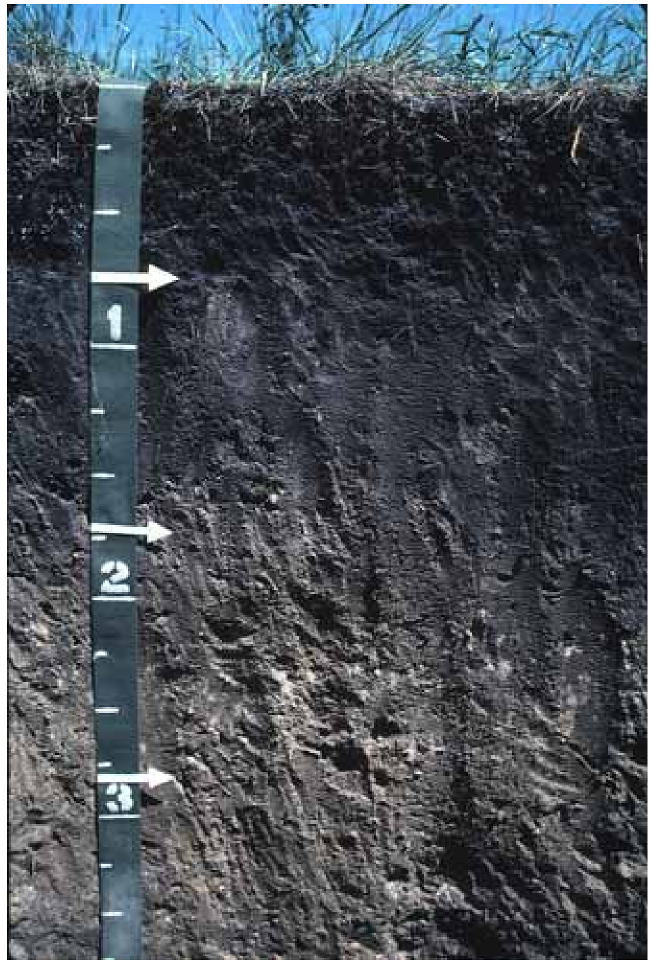

Figure 14. Typical pedon of Vallers loam.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; moderate very fine and fine granular structure; hard, friable, sticky and plastic; strong effervescence; slightly alkaline; abrupt smooth boundary.

Bkg—9 to 22 inches; gray (5Y 5/1) and olive gray (5Y 5/2) clay loam, light gray (5Y 6/1) and light gray (5Y 7/2) dry; many medium prominent yellowish brown (10YR 5/4) redoximorphic concentrations; weak medium subangular blocky structure; hard, firm, sticky and plastic; about 5 percent pebbles and other rock fragments; violent effervescence; slightly alkaline; clear wavy boundary.

Bkyg—22 to 44 inches; olive gray (5Y 5/2) and gray (5Y 5/1) clay loam, light olive gray (5Y 6/2) and light gray (5Y 7/1) dry; many large prominent yellowish brown (10YR 5/4) redoximorphic concentrations; weak fine subangular blocky structure; hard, firm, sticky and plastic; about 5 percent pebbles and other rock fragments; many

nests of gypsum; strong effervescence; slightly alkaline; gradual wavy boundary.

BCyg—44 to 60 inches; gray (5Y 5/1) clay loam, light gray (5Y 6/1) dry; many medium prominent yellowish brown (10YR 5/4) redoximorphic concentrations; massive; very hard, firm, sticky and plastic; about 5 percent pebbles and other rock fragments; common nests of gypsum; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 25 inches
Depth to lime: 0 to 6 inches
Depth to the calcic horizon: 4 to 16 inches
Notes: Some pedons have an ABk horizon. Some pedons have a BCk horizon.

Az horizon:
Hue: 10YR, 2.5Y, 5Y, or neutral
Value: 2 or 3, 3 to 5 dry
Chroma: 0 or 1
Texture: loam or clay loam

Bk horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6
Chroma: 1 or 2
Texture: clay loam, silty clay loam, loam, or sandy clay loam

BC horizon:
Hue: 2.5Y or 5Y
Value: 4 to 7
Chroma: 1 to 3

Velva Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately rapid
Landform: Flood plains
Parent material: Alluvium
Slope: 0 to 6 percent

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Fluventic Haplustolls

Typical pedon:
Velva fine sandy loam, 1,090 feet west and 90 feet north of the southeast corner, sec. 13, T. 144 N., R. 87 W. (Colors are for dry soil unless otherwise stated.)

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; many fine pores; neutral; abrupt smooth boundary.

AC—6 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine pores; slightly alkaline; abrupt smooth boundary.

Ab—12 to 13 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots; many fine pores; slight effervescence; slightly alkaline; clear smooth boundary.

C1—13 to 15 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common roots; common fine pores; strong effervescence; slightly alkaline; clear smooth boundary.

C2—15 to 36 inches; grayish brown (2.5Y 5/2) fine sandy loam with thin strata of loam and loamy fine sand less than 1 inch thick, dark grayish brown (2.5Y 4/2) moist; weak very coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common roots; common fine pores; strong effervescence; slightly alkaline; clear smooth boundary.

C3—36 to 52 inches; grayish brown (2.5Y 5/2) loamy fine sand, very dark grayish brown (2.5Y 3/2) moist; single grain; few roots; strong effervescence; moderately alkaline; clear smooth boundary.

C4—52 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few roots; few pores; strong effervescence; moderately alkaline.

Range in Characteristics

10 to 40 inch particle-size control section: averages 7 to 18 percent clay and 25 and 60 percent fine sand and coarser sand

Notes: Some pedons have Bw or Bk horizons.

Ap horizon:
Hue: 10YR or 2.5Y
Value: 3 to 5, 2 or 3 moist
Chroma: 1 to 3
Texture: loam or fine sandy loam

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 7, 3 to 5 moist
Chroma: 2 to 4
Texture: averages fine sandy loam, very fine sandy loam, or loam

Wabek Series

Depth class: Very deep
Drainage class: Excessively drained
Permeability: Very rapid
Landform: Outwash plains and terraces
Parent material: Glaciofluvial deposits
Slope: 0 to 25 percent

Taxonomic class: Sandy-skeletal, mixed, frigid Entic Haplustolls

Typical pedon:
Wabek loam, 2,490 feet north of the southeast corner, sec. 1, T. 140 N., R. 77 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 5 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; about 3 percent rock fragments; neutral; gradual wavy boundary.

Bk—5 to 9 inches; brown (10YR 4/3) gravelly coarse sandy loam, light brownish gray (10YR 6/2) dry; single grain; common roots; about 25 percent rock fragments; lime crusts coat undersides of rock fragments; strong effervescence; slightly alkaline; diffuse boundary.

C—9 to 60 inches; grayish brown (10YR 5/2) very gravelly coarse sand, pale brown (10YR 6/3) dry; stratified with varying amounts and mixtures of gravel and cobblestones; single grain; few roots in upper 10 inches; about 50 percent rock fragments; strong effervescence, decreasing to slight effervescence in the lower part; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 14 inches
Depth to lime: 0 to 8 inches
Depth to sand and gravel: 7 to 14 inches
Notes: Some pedons have an ABk or BCk horizon.

Ap horizon:
Value: 2 or 3, 3 to 5 dry

C horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 7 dry
Chroma: 2 to 4

Wildrose Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Slow
Landform: Lake plains
Parent material: Glaciolacustrine deposits
Slope: 0 to 1 percent

Taxonomic class: Fine, smectitic, frigid Typic Haplusterts

Typical pedon:
Wildrose clay, 530 feet north and 150 feet west of the southeast corner, sec. 2, T. 159 N., R. 97 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) clay, dark grayish brown (10YR 4/2) dry; moderate medium subangular blocky structure; very hard, very firm, very sticky and very plastic; many very fine and few fine roots; 2 to 15 mm wide vertical cracks about 25 cm apart; slight effervescence; neutral; abrupt smooth boundary.

A—6 to 14 inches; very dark grayish brown (2.5Y 3/2) clay, grayish brown (2.5Y 5/2) dry; moderate medium subangular blocky structure parting to moderate fine platy; extremely hard, extremely firm, very sticky and very plastic; common very fine roots; 2 to 15 mm wide vertical cracks about 25 cm apart; slight effervescence; slightly alkaline; clear smooth boundary.

Bss1—14 to 21 inches; very dark grayish brown (2.5Y 3/2) clay, grayish brown (2.5Y 5/2) dry; strong medium prismatic structure parting to moderate medium angular blocky; extremely hard, extremely firm, very sticky and very plastic; common very fine and few fine roots in pores and along faces of peds and slickensides; few non-intersecting slickensides; 2 to 15 mm wide vertical cracks about 25 cm apart; slight effervescence; slightly alkaline; clear smooth boundary.

Bss2—21 to 31 inches; very dark grayish brown (2.5Y 3/2) clay, grayish brown (2.5Y 5/2) dry; strong medium prismatic structure parting to moderate medium angular blocky; extremely hard, extremely firm, very sticky and very plastic; common very fine roots along faces of peds and slickensides; few very fine roots in pores; common intersecting slickensides; common wedge shape natural aggregates tilted 30 degrees to 60 degrees from horizontal; 2 to 15 mm wide vertical cracks about 25 cm apart; slight effervescence; moderately alkaline; clear smooth boundary.

Bss3—31 to 38 inches; dark olive gray (5Y 3/2) clay, olive gray (5Y 4/2) dry; strong medium prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm, very sticky and very plastic; common very fine roots along faces of peds and slickensides; few very fine roots in pores; few non-intersecting slickensides; slight effervescence; slightly alkaline; clear wavy boundary.

By—38 to 44 inches; dark olive gray (5Y 3/2) clay, olive gray (5Y 5/2) dry; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; extremely hard, extremely firm, very sticky and very plastic; few very fine roots; many fine threads and masses of gypsum; slight effervescence; slightly alkaline; clear wavy boundary.

BC—44 to 58 inches; olive gray (5Y 4/2) clay, olive gray (5Y 5/2) dry; strong coarse prismatic structure parting to moderate medium subangular blocky; extremely hard, extremely firm, very sticky and very plastic; few very fine roots; few fine threads and masses of gypsum; slight effervescence; slightly alkaline; gradual wavy boundary.

C—58 to 60 inches; olive (5Y 4/3) silty clay, pale olive (5Y 6/3) dry; common fine prominent strong brown (7.5YR 5/8) redoximorphic concentrations; massive; extremely hard, extremely firm, very sticky and very plastic; few fine distinct very dark brown (10YR 2/2) manganese stains; slight effervescence; slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to more than 40 inches
Depth to lime: 0 to 30 inches
Notes: Some pedons have a Bk horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2

Bss horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 2 to 4
Chroma: 1 to 3
Texture: silty clay, silty clay loam, or clay

By horizon:
Notes: Some pedons do not have a By horizon.

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 3 to 5, 4 to 7 dry
Chroma: 1 to 4
Texture: silty clay or clay
Notes: It is silt loam below a depth of 40 inches in some pedons.

Williams Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 0 to 35 percent

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Argiustolls

Typical pedon:
Williams loam, 1,050 feet east and 60 feet south of the northwest corner, sec. 5, T. 158 N., R. 94 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; few pebbles; neutral; abrupt smooth boundary.

Bt1—6 to 10 inches; dark brown (10YR 3/3) clay loam, brown (10YR 4/3) dry; strong medium prismatic structure parting to strong medium angular blocky; hard, firm, sticky and plastic; common very fine roots; many distinct clay films on faces of peds and lining pores; few pebbles; neutral; clear wavy boundary.

Bt2—10 to 15 inches; dark grayish brown (10YR 4/2) clay loam, grayish brown (10YR 5/2) dry; moderate medium prismatic structure parting to strong medium subangular blocky; hard, firm, sticky and

plastic; common very fine roots; many distinct clay films on faces of peds and lining pores; slightly alkaline; clear wavy boundary.

Btk—15 to 24 inches; olive brown (2.5Y 4/4) clay loam, light olive brown (2.5Y 5/4) dry; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common very fine roots; few faint clay films on faces of peds; few pebbles; common medium irregular masses of lime; violent effervescence; slightly alkaline; gradual wavy boundary.

Bk—24 to 36 inches; grayish brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/2) dry; weak medium prismatic structure parting to weak medium subangular blocky; soft, friable, sticky and plastic; few very fine roots; few cobbles; lime disseminated throughout and in common masses; violent effervescence; moderately alkaline; gradual wavy boundary.

C—36 to 60 inches; grayish brown (2.5Y 5/2) clay loam, light brownish gray (2.5Y 6/2) dry; few fine prominent yellowish brown (10YR 5/6) dry redoximorphic concentrations and light gray (10YR 7/2) dry redoximorphic depletions; massive; soft, friable, sticky and plastic; few pebbles and cobbles; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to lime: 10 to 24 inches
Notes: Some pedons have a BCk horizon.

Ap horizon:
Value: 2 or 3, 3 or 4 dry

Bt horizon:
Hue: 10YR or 2.5Y
Value: 2 to 5, 4 to 6 dry
Chroma: 2 to 4

Btk horizon:
Notes: Some pedons do not have a Btk horizon.

Bk horizon:
Hue: 10YR or 2.5Y
Value: 3 to 6, 4 to 8 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 6 or 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Wyard Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderate
Landform: Till plains
Parent material: Alluvium
Slope: 0 to 1 percent

Taxonomic class: Fine-loamy, mixed, frigid Typic Epiaquolls

Typical pedon:
Wyard loam, 1,000 feet north and 200 feet east of the southwest corner of sec. 15, T. 148 N., R. 67 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 6 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; weak medium granular structure; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; many worm casts; neutral; abrupt smooth boundary.

A1—6 to 10 inches; black (10YR 2/1), broken face, loam, dark gray (10YR 4/1), broken face, dry; moderate coarse prismatic structure parting to weak coarse subangular blocky and weak medium platy; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; few sand coats on faces of peds; many worm casts; neutral; gradual wavy boundary.

A2—10 to 20 inches; very dark brown (10YR 2/2), broken face, loam, gray (10YR 5/1), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky and moderate medium platy; hard, friable, slightly sticky and slightly plastic; many fine roots throughout; many fine pores; few patchy gray (10YR 6/1), dry, sand coats on faces of peds and few patchy gray (10YR 6/1), dry, silt coats on faces of peds; few medium distinct yellowish brown (10YR 5/4) masses of iron accumulation pedogenic throughout; neutral; clear wavy boundary.

Bw1—20 to 26 inches; dark grayish brown (2.5Y 4/2), broken face, loam, grayish brown (2.5Y 5/2), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky and weak medium platy; hard, friable, slightly sticky and slightly plastic; few roots throughout; many fine pores; common fine prominent yellowish brown (10YR 5/6) masses of iron accumulation pedogenic throughout; neutral; gradual wavy boundary.

Bw2—26 to 32 inches; dark grayish brown (2.5Y 4/2), broken face, loam, light olive brown (2.5Y 5/4), broken face, dry; moderate coarse prismatic structure parting to moderate medium and fine angular blocky; hard, friable, slightly sticky and slightly plastic; few roots throughout; common fine pores; common fine distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic throughout; 2 percent mixed gravel; neutral; clear wavy boundary.

Bk—32 to 42 inches; light olive brown (2.5Y 5/4), broken face, loam, pale yellow (2.5Y 7/4), broken face, dry; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few medium distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic and common masses of lime pedogenic; 2 percent mixed gravel; violently effervescent throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

C—42 to 60 inches; olive brown (2.5Y 4/4), broken face, loam, light yellowish brown (2.5Y 6/4), broken face, dry; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; few medium distinct light olive brown (2.5Y 5/6) masses of iron accumulation pedogenic and few fine masses of lime pedogenic; 2 percent mixed gravel; strongly effervescent throughout (HCl, unspecified); moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 16 to 24 inches
Depth to lime: 20 to 48 inches

Wyndmere Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Coarse-loamy, mixed, superactive, frigid Aeric Calciaquolls

Typical pedon:
Wyndmere fine sandy loam, 455 feet east and 190 feet north of the southwest corner, sec. 9, T. 133 N., R. 49 W. (Colors are for moist soil unless otherwise stated.)

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to moderate medium granular; slightly hard, very friable; many roots; strong effervescence; moderately alkaline; abrupt boundary.

ABk—8 to 15 inches; very dark gray (10YR 3/1) fine sandy loam, gray (10YR 5/1) dry; weak coarse prismatic structure parting to weak coarse angular blocky; slightly hard, very friable; common roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Bk—15 to 26 inches; gray (10YR 5/1) fine sandy loam, light gray (10YR 6/1) dry; weak coarse prismatic structure parting to weak coarse angular blocky; slightly hard, very friable; few roots; violent effervescence; moderately alkaline; gradual wavy boundary.

C1—26 to 44 inches; light olive brown (2.5Y 5/4) fine sandy loam, pale yellow (2.5Y 7/4) dry; few fine prominent dark reddish brown (5YR 3/2) redoximorphic concentrations; weak coarse subangular blocky structure parting to weak coarse granular; slightly hard, very friable; strong effervescence; moderately alkaline; gradual boundary.

C2—44 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam, pale yellow (2.5Y 7/4) dry; many prominent very dark brown (10YR 2/2) and yellowish brown (10YR 5/6) redoximorphic concentrations; massive; slightly hard, friable; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Notes: Some pedons have an Ak horizon.

A horizon:
Value: 2 or 3, 3 to 5 dry
Chroma: 1 or 2

Bk horizon:
Hue: 2.5Y or 10YR
Value: 3 to 6, 4 to 8 dry
Chroma: 1 to 4
Texture: fine sandy loam or sandy loam

C horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 7, 5 to 8 dry
Chroma: 2 to 4

Wyrene Series

Depth class: Very deep
Drainage class: Somewhat poorly drained
Permeability: Moderately rapid in the upper part and rapid in the lower part
Landform: Outwash plains
Parent material: Glaciofluvial deposits
Slope: 0 to 3 percent
Notes: These soils are highly calcareous.

Taxonomic class: Sandy, mixed, frigid Aeric Calciaquolls

Typical pedon:
Wyrene sandy loam, 2,420 feet south and 1,450 feet west of the northeast corner of sec. 22, T. 148 N., R. 64 W. (Colors are for dry soil unless otherwise stated.)

A—0 to 8 inches; dark gray (10YR 4/1), broken face, sandy loam, black (10YR 2/1), broken face, moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many roots throughout; strong effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk1—8 to 13 inches; gray (10YR 6/1), broken face, sandy loam, dark gray (10YR 4/1), broken face, moist; moderate coarse prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common roots throughout; violent effervescence throughout (HCl, unspecified); moderately alkaline; gradual wavy boundary.

Bk2—13 to 21 inches; gray (10YR 6/1), broken face, sandy loam, dark gray (10YR 4/1), broken face, moist; moderate coarse and medium prismatic structure parting to moderate coarse and medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots throughout; violent effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C1—21 to 29 inches; light yellowish brown (2.5Y 6/4) coarse sand, light olive brown (2.5Y 5/4) moist; single grain; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C2—29 to 42 inches; light yellowish brown (2.5Y 6/4) coarse sand, light olive brown (2.5Y 5/4) moist; single grain; common distinct dark yellowish brown (10YR 4/4) moist masses of iron accumulation pedogenic throughout; 3 percent mixed gravel; slight effervescence throughout (HCl, unspecified); moderately alkaline; clear wavy boundary.

2C3—42 to 60 inches; light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) coarse sand, very dark grayish brown (2.5Y 3/2) moist; single grain; 5 percent mixed gravel; slight effervescence throughout (HCl, unspecified); slightly alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 16 inches
Depth to sand and gravel: 20 to 32 inches

A and Bk horizons:
Note: They have up to 10 percent gravel.

2C horizon:
Notes: It has up to 35 percent gravel.

Zahl Series

Depth class: Very deep
Drainage class: Well drained
Permeability: Moderately slow
Landform: Till plains
Parent material: Glacial till
Slope: 3 to 60 percent
Notes: These soils are highly calcareous.

Taxonomic class: Fine-loamy, mixed, superactive, frigid Typic Calciustolls

Typical pedon:
Zahl loam, 2,335 feet east and 25 feet south of the northwest corner, sec. 14, T. 156 N., R. 90 W. (Colors are for moist soil unless otherwise stated.)

A—0 to 5 inches; very dark brown (10YR 2/2) loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure parting to weak medium granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine pores; strong effervescence; slightly alkaline; clear wavy boundary.

Bk—5 to 20 inches; dark grayish brown (2.5Y 4/2) loam, light brownish gray (2.5Y 6/2) dry; weak medium and fine subangular blocky structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; many fine pores; few pebbles; many masses of lime; violent

effervescence; moderately alkaline; gradual wavy boundary.

C—20 to 60 inches; olive brown and light olive brown (2.5Y 4/4 and 2.5Y 5/4) clay loam, light yellowish brown and light olive brown (2.5Y 6/4 and 2.5Y 5/4) dry; common fine faint olive gray (5Y 5/2) dry and common fine distinct gray (5Y 5/1) dry redoximorphic depletions; massive; soft, friable, sticky and plastic; few very fine roots to 40 inches; few pebbles; strong effervescence; moderately alkaline.

Range in Characteristics

Mollic epipedon thickness: 7 to 10 inches
Depth to lime: 0 to 9 inches

Ap horizon:
Hue: 10YR or 2.5Y
Value: 2 or 3, 3 to 5 dry

Bk horizon:
Hue: 10YR, 2.5Y, or 5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

C horizon:
Hue: 10YR or 2.5Y
Value: 4 to 6, 5 to 7 dry
Chroma: 2 to 4
Texture: loam or clay loam

Agronomy

About 59 percent of Burke County is cultivated. In 1998, acreage planted of the principal close-grown crops were as follows: spring wheat, 100,000 acres; durum wheat, 160,000 acres; barley, 24,000 acres; oats, 5,000 acres; and flax, 2,700 acres. The main row crop was sunflowers, both for oil and non-oil. They were planted on 6,600 acres. Alfalfa and other hay crops were planted on 31,500 acres. Small acreages were planted to canola, mustard, lentils, millet, rye, and safflower (Beard and Waldhaus, 1999).

Cropland limitations and general management practices needed for crops and hay and pasture are discussed in this section. Soil interpretive groups used by the Natural Resources Conservation Service for important farmlands, soil productivity indexes, land capability, pasture and hay, and windbreaks are explained. Soil quality and the management of saline and sodic soils are also discussed.

Planners of management systems for individual fields or farms should consider obtaining specific information from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Cropland Limitations and Management

Management concerns affecting the use of detailed map units in the survey area for crops are shown in Table 6, "Potential Cropland Limitations and Hazards." The primary concerns in managing cropland are conserving moisture, controlling wind and water erosion, and maintaining or improving soil fertility and tilth.

Moisture at planting time is critical to the success of the crop during the growing season. In years where the amount of available soil moisture is low at planting time, crop success for the year is greatly reduced. Measures that reduce evaporation and runoff rates, increase the rate of water infiltration, and control weeds conserve moisture.

Applying conservation tillage and conservation cropping systems, farming on the contour, stripcropping, establishing field windbreaks, trapping snow, and leaving crop residue on the surface also conserve moisture. When fallow is used to carry moisture over to the next season, a cover of crop residue is essential during winter to guard against moisture loss and erosion.

Wind erosion may be a hazard on most of the soils in Burke County. It is severe on the coarse textured and moderately coarse textured soils, such as Blanchard, Kratka, Lihen, Parshall, Portal, and Towner. It is also a severe hazard on Divide, Hamerly, Marysland Regan, Sakakawea, Vallers, and Zahl soils. These soils have a relatively high content of lime and are susceptible to wind erosion in the spring if they have been bare throughout the winter. Because of freezing and thawing, soil structure can break down, resulting in aggregates that are susceptible to movement. This can cause fine textured soils, such as Marias and Southam (where drained) to have a severe wind erosion hazard. Nearly all soils can be damaged by wind erosion if they are not protected by residue.

Water erosion is a severe hazard on gently rolling and steeper soils, such as Appam, Sakakawea, Wabek, Williams, and Zahl. The hazard is greatest when the surface is bare.

Conservation practices that control both wind and water erosion are those that maintain a protective cover on the surface. An example is a conservation tillage system that keeps a protective amount of crop residue on the surface. Applications of approved herbicides can help to eliminate the need for summer fallow tillage. Cover crops are also effective in controlling both wind and water erosion. Field windbreaks, annual vegetative barriers, and stripcropping help to control wind erosion. Inclusion of grasses and legumes in the cropping sequence, grassed waterways, diversions, terraces, contour farming, and field stripcropping across the slope help to control water erosion. A management system that includes several measures is the best means of protecting the soil. For example, conservation tillage can control soil blowing during years when the amount of crop residue is adequate, but windbreaks are needed during years when the amount of residue is low.

Measures effective in maintaining or improving soil fertility and tilth include utilizing a nutrient management system that includes applying fertilizer, both organic and inorganic, including manure; incorporating crop residue or green manure crops into the soil; and using proper crop rotations. Wind and water erosion reduce productivity of soils. If the surface layer is lost, most of the available plant nutrients also are lost. As a result, applications of fertilizer are needed to maintain adequate crop production.

Of equal concern is the loss of organic matter through erosion. Soil structure, water infiltration, available water capacity, and tilth are all negatively affected by this loss. As organic matter is lost and the subsoil is exposed and tilled, the remaining soil becomes increasingly susceptible to both wind and water erosion. Controlling erosion helps prevent loss of organic matter and plant nutrients and helps maintain productivity. The level of fertility may be reduced even in areas where erosion is controlled. All soils used for crops generally respond well to a nutrient management system. Proper management of soils includes measures that maintain good tilth. These measures are especially needed on the Alkabo, Cresbard, Heil, Miranda, Niobell, Noonan, and Portal soils which have a sodic subsoil and on the Marias soils that have a silty clay surface layer. Measures that maintain the content of organic matter are very important if good tilth is to be maintained. The traditional practice of clean-tilled summer fallow contributes to the loss of organic matter partly because it increases the susceptibility to erosion.

Additional limitations and management practices are as follows:

Alkalinity. This limitation reduces availability of selected nutrients and is associated with restricted seedling emergence and water infiltration. This limitation can be reduced with a nutrient management system and timely tillage operations. Tilling when the soil is neither too wet nor too dry helps to maintain tilth and prevent surface compaction. Maintaining crop residue on the surface and adding organic material to the plow layer help increase organic matter, prevent surface crusting, and maintain or improve tilth and fertility.

This limitation exists if the soil's pH is more than 7.8 at the surface.

Areas of rock outcrop. These areas are usually not accessible for cultivation and generally are unsuited to cultivated crops and hay and pasture. Farming around these areas may reduce the impact of this limitation on farming operations.

This limitation exists if "rock outcrop" is included in the name of the map unit.

Channels. These areas consist of meandering streams and oxbows. Most areas are isolated by streams or are irregularly shaped and often have standing water in the spring. These areas generally are unsuited to cultivated crops.

This limitation exists if "channeled" is included in the name of the map unit.

Dense layer. This limitation slows water infiltration and restricts root penetration. It can be managed by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, and deep tillage to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if the bulk density is greater than 1.7 in any soil layer.

Depth to rock. This limitation restricts rooting depth. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective on these areas. Some areas that are less than 20 inches to bedrock are not suitable for cultivated crops.

This limitation exists if soft or hard bedrock is within a depth of 40 inches.

Depth to sand and gravel. This limitation restricts rooting depth and may increase the potential for pesticide and nutrient leaching. It can be managed by planting shallow-rooted, moisture-efficient crops adapted to the area. A moisture conservation program may be effective in these areas. Some areas less than 12 inches to sand and gravel are not suitable for cultivated crops.

This limitation exists if there is more than 35 percent gravel in any soil layer at a depth of less than 40 inches.

Excessive saturated hydraulic conductivity. This limitation may cause deep leaching of nutrients and pesticides. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the saturated hydraulic conductivity of any soil layer is 6 inches per hour or more.

Flooding. This limitation can affect the timely seeding and survival of crops. In some situations this limitation can be managed by protecting the soil from flooding by diking or by building water retention structures and by planting vegetation that is adapted to flooded conditions. Some areas may be unsuitable for cultivated crops or protection measures may not be economical.

This limitation exists if the map unit is either

occasionally flooded for long or very long periods or frequently flooded.

Gullies. This limitation makes cultivation difficult and hazardous. Generally, gullies are so deep that extensive reshaping is necessary for most uses. They generally are unsuited to cultivated crops, hay, and pasture.

This limitation exists if "gullied" is included in the name of the map unit.

High sodium content. This limitation restricts root, air, and water penetration in the subsoil. It may cause poor tilth and compaction. Tillage at the proper moisture content helps to maintain tilth. Tillage that loosens the dense, sodic subsoil or growing deep-rooted legumes, such as alfalfa and sweetclover, may improve soil physical conditions. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the sodium adsorption ratio (SAR) is more than 15 within a depth of 30 inches or if the soil is classified as any subgroup of Natrudolls or Natrustolls except Glossic or Glossic Vertic.

High water table. Wetness in undrained areas can delay tillage, seeding, and harvest operations in most years and prevent them in some years. Drained areas are suited to cultivated crops but locating suitable drainage outlets generally is difficult. Planting crops that are tolerant to wetness minimizes the impact of the high water table.

This limitation exists if the water table is within a depth of 36 inches.

Lime content. High lime content at the surface may cause increased wind erosion and surface crusting. It may also reduce availability of selected nutrients. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and annual buffer strips to help control wind erosion. Field windbreaks planted on slopes greater than 8 percent may contribute to water erosion by concentrating spring runoff. Crops may respond well to a nutrient management system that includes additions of phosphate fertilizer.

This limitation exists if the soil is assigned to wind erodibility group 4L or averages more than 5 percent $CaCO_3$ equivalent in the upper 10 inches.

Limited available water capacity. This limitation reduces the capacity of the soil to retain moisture for plant use. A moisture conservation program can help manage these areas.

This limitation exists if the available water capacity calculated to a depth of 60 inches or to a root-limiting layer is 8.5 inches or less or the electrical conductivity (EC) is more than 8 at less than 30 inches and the soil is moderately well drained or better.

Limited organic matter. This limitation may cause an increase in surface crusting and reduce the soil's natural fertility. Soil organic matter can be managed by utilizing a nutrient management system, incorporating crop residue or green manure crops into the soil, and using proper crop rotations.

This limitation exists if the content of organic matter is 1 percent or less in the surface layer.

Pesticide and nutrient leaching. This limitation increases the hazard of contaminating aquifers, springs, and local water tables. A nutrient and pesticide management system with a moisture conservation program, which includes following pesticide labels and fertilizing based on soil nutrient tests, can help manage these areas. Some areas may be unsuitable for cultivated crops.

This limitation exists if the depth to the water table is 48 inches or less, depth to bedrock is less than 60 inches, or saturated hydraulic conductivity of any soil layer is 6 inches per hour or more.

Pesticide and nutrient runoff. This limitation increases the hazard of contaminating surface waters, such as lakes, ponds, streams, and rivers. It can be managed with nutrient, pesticide, and conservation tillage systems which include leaving crop residue on the surface, following pesticide labels, and fertilizing based on soil nutrient testing. Limiting row crops on slopes of more than 8 percent reduces the rate of runoff of pesticides and nutrients. Runoff from upland areas can concentrate pesticides on ponded soils. Draining ponded areas may adversely affect the receiving surface waters.

This limitation exists if the soil is occasionally flooded or frequently flooded; is subject to ponding; is assigned to hydrologic group C or D and has a slope of more than 2 percent; is assigned to hydrologic group A and has a slope of more than 6 percent; or is assigned to hydrologic group B, has a slope of 3 percent or more, and has a K factor of more than 0.17.

Ponding. This limitation can affect the timely seeding, harvesting, and survival of crops. Because of wetness and ponding, this soil generally is unsuited to cultivated crops, hay and pasture, and range.

This limitation exists if ponding occurs on the soil.

Poor tilth and compaction. This limitation restricts seedling emergence and water infiltration. It can be managed by timely tillage operations, maintaining crop residue on the surface, and adding organic material to the plow layer to increase soil organic matter. A cropping system that includes deep-rooted legumes,

such as alfalfa and sweetclover, may improve root and water penetration.

This limitation exists if the upper 10 inches of the soil has more than 35 percent clay; has less than 1 percent organic matter; or has SAR of 5 or more.

Restricted saturated hydraulic conductivity. This limitation restricts root penetration and water saturated hydraulic conductivity. It can be managed with timely tillage operations and by using a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, to improve root and water penetration. Incorporating organic material into the soil also helps to improve root and water penetration.

This limitation exists if saturated hydraulic conductivity is 0.06 inch per hour or less within a depth of 40 inches.

Root limiting. This limitation reduces the effectiveness of roots when the soil dries and increases moisture stress during extended dry periods. It can be managed with a cropping system that includes deep-rooted legumes, such as alfalfa and sweetclover, and deep tillage to improve root and water penetration in the subsoil. Tillage when the soil is neither too wet nor too dry helps to maintain tilth. A moisture conservation system may be beneficial. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the soil is classified as a Glossic or Glossic Vertic Natrudoll or Natrustoll.

Salt content. This limitation interferes with plant growth by restricting nutrient uptake and reducing available water. Using nutrient management and moisture conservation systems and growing salt-tolerant crops, such as barley, can help manage these areas. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if the soil has an EC of more than 4 in the surface layer or more than 8 within a depth of 30 inches.

Slick spots. The surface of these areas is nonvegetated and tends to puddle upon wetting. Slick spots are restrictive to air, water, and roots. These areas are best suited to range. Because of the dense and massive layers, they generally are unsuited to cultivated crops, hay, and pasture. For additional information about managing these soils see "Management of Saline and Sodic Soils."

This limitation exists if "Slick spot" is included in the name of the map unit.

Slope. This limitation increases the potential for accelerated water erosion unless conservation farming practices are applied.

This limitation exists if the upper slope range of the map unit is more than 8 percent.

Soil slumping. This limitation indicates a potential for mass soil movement. These areas generally are unsuited to cultivated crops, hay, and pasture.

This limitation exists if the slope is more than 35 percent and the surface or subsoil has more than 35 percent clay; or if the slope is more than 25 percent and the subsoil contains more than 35 percent clay and bedrock is at a depth of less than 60 inches; or if "slumped" is a modifier of any named component of the map unit.

Surface crusting. This limitation restricts seedling emergence and water infiltration. It can be managed with a system of conservation tillage that leaves crop residue on the surface and by incorporating organic material into the surface layer.

This limitation exists if the surface texture is silt, silt loam, silty clay loam, or very fine sandy loam and the surface layer organic matter content is less than 3 percent; or if the surface texture is loamy very fine sand, very fine sandy loam, fine sandy loam, sandy loam, sandy clay loam, loam, clay loam, silt, silt loam, or silty clay loam and the surface layer Calcium Carbonate Equivalent ($CaCO_3$) is equal to or greater than 1; or if the surface layer or upper 10 inches has a SAR of 4 or more.

Surface rock fragments. This limitation adversely affects the use of mechanical equipment for cultivation and causes rapid wear of tillage equipment and difficult seedbed preparation. It cannot be easily overcome. These areas are generally unsuited to cultivated crops, hay, and pasture.

This limitation exists if the texture of the surface layer includes any rock fragment modifier except for gravelly or channery and "surface stones" are not already indicated as a limitation.

Surface stones. This limitation restricts normal cultivation practices. These areas are generally unsuited to cultivated crops, hay, and pasture. Economic removal of the surface stones generally is not feasible.

This limitation exists if the surface layer texture includes stony or bouldery modifiers or if "stony" or "bouldery" are included in the map unit name.

Water erosion. This limitation indicates an increased hazard of water erosion. This limitation can be managed by a system of conservation tillage that leaves crop residue on the surface, contour stripcropping, and grassed waterways in areas where runoff concentrates.

This limitation exists if the surface K factor (soil erodibility factor) multiplied by the upper slope percent is more than 2.

Wind erosion. This limitation indicates an increased hazard of wind erosion. This limitation can be managed by using a system of conservation tillage that leaves crop residue on the surface, field windbreaks, stripcropping, annual crop barriers, and a cropping sequence that includes grass-legume hay.

This limitation exists if the wind erodibility group is 1, 2, 3, 4, or 4L.

Erosion Factors

Soil erosion factors are used with other information to estimate the amount of soil lost through water and wind erosion. The procedure for predicting soil loss is useful in guiding and comparing the selection of soil and water conservation practices. The soil erodibility factors (K and Kf), the soil-loss tolerance factor (T), wind erodibility index (I) and wind erodibility groups (WEG) are described in "Physical Properties" in the "Soil Properties" section. Additional information about soil factors affecting wind and water erosion can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service.

Prime Farmland and Other Important Farmland

In this section, prime farmland and other important farmland are defined. The map units in the survey area that are considered prime farmland, prime farmland where drained, farmland of statewide importance, or other land are listed on Table 7, "Map Unit Productivity Index and Farmland Designation." Most map units have minor areas or inclusions that do not meet the listed farmland designation. More information about the criteria for prime farmland and other important farmland can be obtained at the local office of the Natural Resources Conservation Service.

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses. It could be cultivated land, pastureland, forest land, or other land, but it is not urban, built-up land, or water areas. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce sustained high yields of crops in an economic manner.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, an acceptable salt and sodium content, and few or no rocks. It is permeable to water and air. It is not excessively erodible or saturated with water for long periods, and it is not frequently flooded during the growing season or it is protected from flooding. The slope ranges mainly from 0 to 6 percent.

Soils with a seasonal high water table may qualify as prime farmland where this limitation is overcome by drainage measures. Onsite evaluation is necessary to determine the effectiveness of corrective measures.

A recent trend in land use in some parts of the nation has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive.

About 70,600 acres, or nearly 10 percent of the survey area, meets the requirements for prime farmland. The location of each map unit is shown on the detailed soil maps. The soil qualities that affect use and management are described in the section "Detailed Map Units" and "Soil Series and Their Morphology."

Farmland of Statewide Importance

Some areas, other than areas of prime farmland, are of statewide importance in the production of food, feed, fiber, forage, and oilseed crops. The criteria used in defining and delineating these areas are determined by appropriate state and federal agencies. Generally, farmland of statewide importance includes areas that nearly meet the criteria for prime farmland and that economically produce high yields of crops when treated and managed with acceptable farming methods. Some areas can produce as high a yield as areas of prime farmland if conditions are favorable.

Other Land

Lands not meeting the criteria for Prime Farmland or Additional Farmland of Statewide Importance are placed into Other Land on Table 7, "Map Unit Productivity Index and Farmland Designation."

This group includes Farmland of Local Importance,

Unique Farmland, and Other Land. These farmlands may have agricultural or nonagricultural uses.

Productivity Indexes and Crop Yield Estimates

Productivity indexes are relative ratings of the ability of a soil to produce a particular crop yield in comparison to other soils. They are useful in estimating long-term average crop yields, comparing the production capacity of soils, and analyzing economic impacts. Productivity indexes are shown in Table 7, "Map Unit Productivity Index and Farmland Designation." The average yields per acre that can be expected of the principal crops grown in the county under a high level of management are shown in Table 8, "Yields per Acre of Crops." Productivity indexes are given for drained conditions and, where applicable, undrained conditions.

Productivity indexes are based on soil properties important to crop production. Knowledgeable and experienced soil scientists, conservationists, and university researchers developed the indexes. They used results from field trials, demonstrations, records, and experiences of producers (Ulmer and Patterson, 1988 a, b, c). In North Dakota, productivity indexes are based on long-term average spring wheat production. Similar and contrasting map unit inclusions are considered along with the named map unit components when the productivity index is calculated. The index ranges from 0, which indicates no long term economic production, to 100, which indicates the highest potential production. Productivity indexes and yields are based on the best available information, but they are difficult to determine for soils with variable properties such as salinity, sodicity, and degree of drainage.

In Burke County, a productivity index of 100 was considered equal to a long term average yield of 41 bushels per acre of spring wheat. Multiplying the productivity index by 41 and dividing the product by 100 converts the index number to a figure representing the expected long-term average yield per acre. For example, map unit 2014 Williams-Bowbells loams, 0 to 3 percent slopes, has a productivity index of 90. This number multiplied by 41 and then divided by 100 converts to 37, which is the expected long-term average yield of spring wheat in bushels per acre for this map unit. In any given year, yields may be higher or lower than those indicated in the table because of variations in management, rainfall, and other production and climatic factors. Estimated yields reflect the productive capacity of each soil for each of the principle crops. Yields are likely to increase as new production technology is developed. Productivity of a given soil compared with that of other soils, however, is not likely to change.

Management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include nutrient management systems, moisture conservation, and conservation tillage.

Crops other than those shown in the table are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or the Cooperative Extension Service can provide information about the management and productivity of soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. Soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Criteria used in grouping the soils do not take into account extensive and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland, or engineering purposes. The capability classification of each map unit is given in Table 9, "Interpretive Groupings Report."

In the land capability system, as described in "Land Capability Classification" (USDA-SCS, 1961), soils generally are grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. Capability classes are given for drained conditions and, where applicable, undrained conditions.

Capability classes, the broadest groups, are designated by numerals 1 through 8. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class 1 soils have few limitations that restrict their use.

Class 2 soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class 3 soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.

Class 4 soils have very severe limitations that reduce the choice of plants and require very careful management, or both.

Class 5 soils are not likely to erode but have other limitations, such as wetness, that are impractical to remove and limit their use.

Class 6 soils have severe limitations that make them generally unsuitable for cultivation.

Class 7 soils have very severe limitations that make them unsuitable for cultivation.

Class 8 soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are designated by adding the letter, “e, w, s,” or “c,” to the class numeral, for example, 2e. The letter “e” shows the main hazard is the risk of erosion unless a close-growing plant cover is maintained; “w” shows that water in or on the soil interferes with plant growth or cultivation (in some soils wetness can be partly corrected by artificial drainage); “s” shows the soil is limited mainly because it is droughty, stony, or saline; and “c,” used in only some parts of the United States, shows the chief limitation is climate that is very cold or very dry.

There are no subclasses in class 1 because soils of this class have few limitations. Class 5 contains only the subclasses indicated by “w, s,” or “c” because the soils in class 5 are subject to little or no erosion. They have other limitations that restrict their use mainly to pasture, rangeland, woodland, wildlife habitat, or recreation. There are no subclasses in class 8.

Pasture and Hayland Interpretations

Pastureland is land devoted to the production of adapted introduced or native forage plants for grazing by livestock. Hayland is land primarily used for the production of hay from long-term stands of adapted forage plants. Both pastureland and hayland receive cultural treatments to enhance forage quality and yields. Because of the relatively short growing season, some producers have established cool-season tame pasture to complement the forage produced on rangeland and to extend the grazing season in the spring and fall.

Generally, large amounts of hay are needed to maintain livestock through the long, harsh winters. Hay was harvested on about 31,500 acres in Burke County in 1998 (Beard and Waldhaus, 1999).

Proper pasture or hayland management is essential for the production of high-quality forage, stand survival, and erosion control. Proper grazing management on pastureland during the growing season helps plants maintain sufficient and vigorous top and root growth for sustained production. Brush and weed control is essential in many areas. Fertilizer increases production and enhances longevity of stands. Rotation grazing and renovation also are important management practices.

Soils are assigned to pasture and hayland groups according to their suitability for production of forage under intensive management. Soils in each suitability group are similar enough to be suited to the same species of grasses or legumes. They also have similar management concerns, productivity levels, and limitations and hazards.

Pasture and hayland suitability groups are given in Table 9, "Interpretive Groupings Report." They are given for drained conditions and, where applicable, undrained conditions. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information on adapted varieties and forage yields.

Pasture and Hayland Groups

The following paragraphs describe the Pasture and Hayland Groups in Major Land Resource Areas (MLRA) 53A and 53B which include Burke County. The paragraphs specify the production potential under improved management and list representative adapted species for each group. The notations in parenthesis following the group name are suitability group reference symbols, often used in lieu of the name.

Clayey. (A4) These soils are deep and well, moderately well, and somewhat poorly drained. They are moderately fine and fine textured soils on uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, Russian wildrye, Altai wildrye, intermediate and pubescent wheatgrass, crested wheatgrass, hard fescue, western wheatgrass, green needlegrass, slender wheatgrass, switchgrass, and sweetclover.

Clayey Subsoils. (F1) These soils are deep and moderately well and well drained. They are medium to fine textured soils on uplands. They have a claypan that is a moderate restriction to root growth. Otherwise, these soils have few limitations for the management and growth of adapted plants. Production potential is moderate to high. Suitable forage species include

crested wheatgrass, smooth bromegrass, Russian wildrye, intermediate and pubescent wheatgrass, western wheatgrass, green needlegrass, alfalfa, and sweetclover.

Claypan. (G1) These soils are deep and somewhat poorly to well drained. They are moderately coarse to fine textured soils on uplands. The claypan is dense with very little root penetration. Typically, these soils are strongly alkaline in the claypan and below. These soils are saline below 16 inches. Production potential is low. Suitable forage species include western wheatgrass, slender wheatgrass, crested wheatgrass, alfalfa, and sweetclover.

Limy Subirrigated. (A5) These soils are deep and somewhat poorly drained. They are moderately coarse to moderately fine textured, calcareous soils on uplands. They typically have a water table at about 1.5 to 3.5 feet during spring and early summer. The hazard of wind erosion is a concern during establishment. Production potential is high. Suitable forage species include big bluestem, indiangrass, switchgrass, little bluestem, tall wheatgrass, intermediate and pubescent wheatgrass, slender wheatgrass, alfalfa, birdsfoot trefoil, and sweetclover.

Loamy and Silty. (A1) These soils are deep and mostly well and moderately well drained. They are medium textured soils on uplands. They have few limitations for the management and growth of adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, Russian wildrye, Altai wildrye, intermediate and pubescent wheatgrass, western wheatgrass, switchgrass, indiangrass, big bluestem, thickspike wheatgrass, slender wheatgrass, green needlegrass, alfalfa, and sweetclover.

Moderately Deep Sandy. (F3) These soils are moderately deep, well and somewhat excessively drained. They are moderately coarse textured soils on uplands. These soils are underlain by weathered sandstone or mudstone at depths of 20 to 40 inches. Root penetration is limited by the bedrock. Production potential is low to moderate. Species suitable for planting include prairie sandreed, green needlegrass, western wheatgrass, sand bluestem, switchgrass, crested wheatgrass, and sweetclover.

Moderately Deep Silty. (F2) These soils are moderately deep and well drained. They are medium and moderately fine textured soils on uplands. Weathered siltstone or shale bedrock is at depths of 20 to 40 inches. Root penetration is limited by bedrock. Production potential is moderate to high. Suitable forage species include smooth bromegrass, Russian wildrye, intermediate and pubescent wheatgrass, crested wheatgrass, western wheatgrass, slender wheatgrass, green needlegrass, sideoats grama, alfalfa, and sweetclover.

Overflow and Run-On. (A3) These soils are deep and well to moderately well drained. They are moderately coarse to fine textured soils on flood plains or upland swales and in drainageways. Landscapes are typically plane or concave and receive run-on water from adjacent areas. Some soils are subject to flooding. Soils in this group have few limitations for adapted plants. Production potential is high. Suitable forage species include smooth bromegrass, meadow bromegrass, intermediate and pubescent wheatgrass, Russian wildrye, Altai wildrye, western wheatgrass, thickspike wheatgrass, green needlegrass, slender wheatgrass, big bluestem, indiangrass, switchgrass, alfalfa, and sweetclover.

Saline. (G4) These soils are deep and somewhat poorly and poorly drained. They are coarse to fine textured, saline soils. The available water capacity is moderate because of salinity. Adapted plant species are those with moderate to high salt tolerance. Severely affected areas will need to be seeded and then mulched to reduce salt concentrations during seedling establishment. The better suited forage species include tall wheatgrass, western wheatgrass, thickspike wheatgrass, slender wheatgrass, streambank wheatgrass, alkali sacaton, alsike clover, and sweetclover. Late fall, dormant seedings are recommended.

Sands. (A7) These soils are deep and moderately well to excessively drained. They are coarse textured soils on uplands and flood plains. Wind erosion is a severe hazard during establishment and renovation. Production potential is moderate to high. Species selection is limited for pasture and hayland. Suitable forage species include sand bluestem, switchgrass, prairie sandreed, intermediate and pubescent wheatgrass, and alfalfa.

Sands Soils. (H5) These soils are deep and moderately well to excessively drained. They are very sandy soils. The soils have a severe wind erosion hazard and are very droughty. They are low in organic matter and very fragile. Blowouts are common. These soils are not suited to pasture and hayland planting. Cultivated areas should be converted to rangeland.

Sandy. (A6) These soils are deep and well and moderately well drained. They are moderately coarse textured soils on uplands and flood plains. The hazard of wind erosion is a concern during establishment and renovation. Production potential is high. Species selection is somewhat limited. Suitable forage species include green needlegrass, western wheatgrass, slender wheatgrass, sand bluestem, prairie sandreed,

switchgrass, intermediate and pubescent wheatgrass, alfalfa, and sweetclover.

Shallow. (H4) These soils are shallow and well to excessively drained. They are coarse to fine textured soils on uplands. They are less than 20 inches to weathered bedrock and have a severe water erosion hazard. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Shallow to Gravel. (B1) These soils are deep and well to excessively drained. They are medium to coarse textured soils on outwash plains. They typically have gravel and/or coarse sand at depths from 14 to 24 inches. These soils are droughty. Production potential is moderate. Only drought-tolerant species such as western wheatgrass, crested wheatgrass, intermediate and pubescent wheatgrass, alfalfa, and sweetclover should be planted.

Sodic-Saline. (G3) These soils are deep and poorly drained. They are moderately coarse to fine textured claypan soils. These soils occur in drainageways, basins, and upland depressions. They typically are strongly alkaline and saline. Plant selection is limited because of the wetness, salinity, and alkalinity. Production potential ranges from low to moderate. Establishment is difficult, so mulching is recommended on more severely affected areas. Suitable forage species include tall wheatgrass, western wheatgrass, slender wheatgrass, streambank wheatgrass, switchgrass, alkali sacaton, alsike clover, and sweetclover. Late fall, dormant seedings are recommended.

Steeply Sloping. (H3) These soil areas are on slopes that average 25 percent or greater. Water erosion is a very severe hazard. These soils are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Stony. (H2) These are very stony and extremely stony soils. They are not suited to pasture and hayland plantings. Cultivated areas that have had stone removal should be treated the same as the nonstony phase of the same soil in regard to pasture and hayland planting.

Strongly Saline. (H1) These are deep, poorly drained, moderately fine textured, strongly saline soils. High salinity makes it extremely difficult to establish grass stands. They are not suited to pasture and hayland plantings. Cultivated areas should be converted to rangeland.

Thin Claypan. (G2) These soils are deep and somewhat poorly to well drained. They are medium to fine textured thin claypan soils on uplands. The claypan is very dense with very little root penetration. Typically they are strongly alkaline in the claypan and below. They are saline within 16 inches of the surface. Production potential is very low to low. Species selection is extremely limited. The best suited forage species include western wheatgrass, slender wheatgrass, crested wheatgrass, and alfalfa. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Thin Upland. (A2) These soils are deep and well and excessively drained. They are medium textured soils on uplands. They are on ridges, knobs, and other convex positions subject to runoff. The hazards of wind and water erosion are concerns during establishment. Production potential is moderate. Suitable forage species include intermediate and pubescent wheatgrass, crested wheatgrass, western wheatgrass, green needlegrass, prairie sandreed, little bluestem, sideoats grama, alfalfa, and sweetclover

Very Shallow to Gravel. (B2) These soils are deep and well to excessively drained. They are medium to moderately coarse textured soils on outwash plains and scoria topped buttes. They typically have coarse sand and gravel or shattered porcelanite at depths of less than 14 inches. These soils are very droughty. Production potential is low and species selection is severely limited. Suitable species include crested wheatgrass, western wheatgrass, thickspike wheatgrass, and slender wheatgrass. Where cultivated, returning these soils to rangeland may be a better alternative than pasture or hayland.

Wet. (C1) These soils are deep and poorly drained. They are coarse to fine textured soils on flood plains or low areas on till and lake plains. Wetness limits selection of locally adapted forage plants. Production potential is high to very high. Select plant species on the basis of flooding tolerance or inundation tolerance. Suitable species include reed canarygrass, creeping foxtail, big bluestem, switchgrass, indiangrass, western wheatgrass, intermediate and pubescent wheatgrass, smooth bromegrass, tall wheatgrass, and alsike clover.

Wetland. (H6) These soils are deep and very poorly drained. They are coarse to fine textured soils. They are usually too wet for cultivation and are not suited to pasture and hayland plantings unless drained. If drained, treat the same as the “Wet” pasture and hayland group.

Management of Saline and Sodic Soils

Saline and sodic soils make up less than 25 percent of Burke County. Saline soils make up about 7,100 acres; sodic soils also make up about 137,075 acres; and saline-sodic soils make up about 32,340 acres.

Saline soils have a high concentration of soluble

salts, or salts that dissolve in water. Saline soils in Burke County are phases of the Regan and Vallers series.

Saline soils generally develop in areas of restricted drainage, such as those adjacent to sloughs and waterways. Where drainage is poor, salts rise with the water table and are concentrated near the surface. This salt buildup is reduced by plants and a surface cover. The plant roots use the soil water before it can reach the surface and before the salts accumulate. The surface cover prevents evaporation at the surface, the upward movement of water in the soil, and the concentration of salts at the surface (Seelig and Richardson, 1991).

Plants growing on saline soils absorb salts from the soil water. Excess amounts of certain salts may interfere with plant growth. High concentrations of some salts are toxic to certain plants. Some salts cause nutritional imbalances or deficiencies by restricting the uptake or availability of certain plant nutrients. Detecting salinity by visual observations in the field is difficult. The salts are generally not visible during much of the growing season, particularly when the soil is moist. Flecks, threads, or masses of soluble salts are usually visible when the soil is dry. Laboratory analysis or special field instruments are needed to determine the actual degree of salinity in soils.

Crop response, particularly during periods of soil moisture stress, is a useful indicator of the degree of salinity in saline soils. For instance, a small grain crop growing on saline soils tends to be stunted and has fewer tillers than small grain on nonsaline soils. Strongly saline soils are best suited to native grasses or to salt-tolerant introduced grasses. Slightly saline or moderately saline soils can produce salt-tolerant crops and forage. Barley is the most salt-tolerant of the small grains. Of the forage crops, tall wheatgrass, western wheatgrass, and alfalfa are salt tolerant once they are established. Continuous cropping is beneficial because it reduces evaporation and salt accumulation in the surface layer.

Sodic soils are characterized by a high content of exchangeable sodium which adheres to the clay particles in the soil (Seelig and Richardson, 1991). The sodic soils in Burke County are phases of the Alkabo, Cresbard, Miranda, Niobell, Noonan, and Portal series. Locally, sodic soils are known as "black alkali," "slick spots," "pan spots" or "gumbo."

Sodic soils develop in a complex pattern with a very distinct microrelief. The physical and chemical properties of these soils differ markedly within very short distances. In many areas the distance between the sodic soils and the surrounding soils that have normal physical properties is only a few feet.

Sodic soils developed in areas of saline soils that contained large quantities of sodium salts. Over a long period, usually centuries, as the water table lowers, precipitation gradually leaches the salts from the surface to lower horizons. During this leaching process, the clay in the soil becomes saturated with sodium, disperses, and moves downward with the percolating water. As the moving clay concentrates, a dense, sodic subsoil forms. (fig. 15) The dense subsoil is hard when dry, sticky when wet, and nearly impervious to roots, water, and air. Examples are the Noonan and Portal soils.

As the leaching by soil water continues, the sodium is gradually moved lower in the soil profile and eventually is carried below rooting depth. The result is a more manageable soil, such as Alkabo, Cresbard, and Niobell. If the leaching process continues and nearly all of the sodium is removed from the profile, the soil eventually changes into a nonsodic soil. This change requires a long period, usually centuries.

If plowed, sodic soils are characterized by a surface layer that is sticky when wet and hard and cloddy when dry. A crust forms easily at the surface. The chemical and physical properties of these soils are unfavorable for plant growth. The harmful effects of the properties on plants generally increase as the sodium content increases. The effects of the reduced amount of water available to plants are more harmful than the toxic effect of the sodium. The plants also are affected by the depth to the dense subsoil.

Identification of sodic soils in cultivated fields commonly is difficult because many of the physical characteristics, such as columnar structure, have been altered by tillage. Crop response, particularly during periods of soil moisture stress, is a useful indicator of the level of sodicity in a soil. Crops grown on soils with varying amounts of sodium exhibit varying heights and stages of development. If the level of sodicity is very high, the crop cannot grow. The effects of sodium on crop growth are influenced by weather conditions, stage of crop growth, and soil moisture status. A measure of the effect of sodicity on vegetative growth is not necessarily a reliable measure of crop yields. In many areas, the yields of barley and wheat are affected less than the vegetative growth of these crops.

Variability of sodic soils can cause management problems. Soils that have a dense, sodic subsoil near the surface, such as Miranda, are better suited to grass than to small grain and sunflowers. Timely tillage

Figure 15. A dense sodic subsoil restricts the penetration of roots.

is an important management need in areas of sodic soils. These areas should be tilled and seeded only when the moisture content is favorable. If worked when too wet, the soils puddle and crust. If the soils are tilled when too dry, tillage and seeding implements cannot easily penetrate the soils. Deep plowing and chemical amendments can help to reclaim sodic soils, but they may not be feasible. To be effective, deep tillage should reach below the sodic subsoil and mix several inches of the underlying material with the subsoil and topsoil. Depending on the soil, tillage to a depth of 15 to 36 inches may be needed. Any reclamation of sodic soils is a long-term endeavor. Complete reclamation may never be achieved. Onsite investigation is needed to confirm the feasibility of deep tillage in a particular area.

Saline-sodic soils develop in areas of restricted drainage where salts rise with the water table but where some downward leaching of clay and some saturation with sodium are evident and a dense, sodic subsoil has formed. Examples are the Harriet, Heil, and Stirum soils. The management needs and crop responses on these soils are a combination of those on saline soils and those on sodic soils.

Additional information about management or reclamation of saline and sodic soils is available from the Natural Resources Conservation Service, the North Dakota Agricultural Experiment Station, and the Cooperative Extension Service (Franzen, et. al., 1994).

Soil Quality

Definition of Soil Quality

Soil quality is the ability of a soil to function within its surroundings, support plant and animal productivity, and maintain or enhance water and air quality. This is also referred to as soil health.

Functions of Soil

Soil is a living, dynamic resource. It has biological, chemical, and physical properties which are continually changing. Soil provides a physical, chemical, and biological environment for the exchange of water, air, and nutrients necessary for living organisms.

Soil controls the movement of rainfall or irrigation water on the land. Some of the water runs off the soil and directly enters surface water drainage systems. The remaining water either evaporates or infiltrates the soil. There it is stored and used for plant growth or percolates through the soil into the ground water. This control of water flow affects the movement of soluble materials, such as nitrate nitrogen and pesticides, through the environment.

Soil regulates biological activity and chemical exchanges. This affects nutrient cycling, plant growth, and decomposition of organic materials. Soil also acts as a filter to protect the quality of water and air. It provides mechanical support and a rooting environment for living organisms.

Soil quality can be viewed in two ways: In the first view, some soils are better suited than others to perform specific functions. For example, soils that are shallow to bedrock are poorly suited for supporting deep-rooted crops or trees. Soils high in sand and gravel content may have an inherently poor quality for filtering septic system wastes. Alternatively, these same soils may have a high

quality or suitability for road and street construction. This view of soil quality is useful when comparing soils and is often used to evaluate the suitability of soils for specific uses.

The second view of soil quality relates to the dynamic nature of soils. Even though a soil may have a certain ability or level of quality for a specific activity, it may be functioning at a level below its inherent capability. This may be due to past disturbance or current management systems. For example, a farming system that does not protect the surface layer from erosion may result in soil erosion and loss of organic matter, nutrients, and other beneficial properties. In most cases, the eroded soil functions at less than its original potential for production. Its condition or health is considered impaired or lower in quality. In another example, a soil in a wetland, if drained or covered with sediment from nearby uplands, may not serve as effectively as a filter as it would in its natural condition.

Importance of Soil Quality to Landowners

Soil quality has a direct affect on plant growth and productivity for crop, range, hay, and woodland production. It affects how water moves into and through the soil. Maintaining or enhancing soil quality can help reduce the negative effects of soil erosion. Increasing soil quality can reduce the movement of nitrates and other chemicals to adjacent water bodies and ground water. Maintaining a high level of soil quality will ensure the soil resource is sustained for the future.

Many soils have undergone a degradation of their inherent quality through past agricultural operations. However, improved management practices, such as conservation tillage, implementing nutrient and moisture management systems, and establishment of riparian buffers or windbreaks can improve soil quality. As a rule, management practices that maintain a vegetative cover on the soil, return the maximum practical amount of residue, and minimize soil disturbance (tillage), will result in higher levels of soil quality.

Degradation of soil quality can have negative effects on the soil resource and costly offsite impacts. Soil erosion and the consequential deposition of sediment by wind or water are examples. Other negative effects of soil degradation include: compaction and loss of granular structure of surface soil layers, reduction of infiltration rates and organic matter levels, and formation of surface crusts. Degradation of soils can also lead to nutrient loss or imbalances, pesticide carryover, and reduced biological activity.

Soil Quality Indicators

The quality of most soils can be improved over time if managed properly. Key indicators of soil quality can be observed and monitored periodically to ensure the quality of the soil is maintained or enhanced.

Soil quality indicators are soil properties or processes that can be monitored to establish changes in the soil. Indicators can be categorized into four general groups: visual (sensory), physical, chemical, and biological.

Visual indicators may be obtained from observation or photographic interpretation. Exposure of subsoils, change in soil color, ephemeral gullies, ponding, plant response, and surface crusting are a few examples. Visual evidence can be a clear indication that soil quality is changing in either a negative or a positive way. The senses of feel and smell can also be used to evaluate certain soil properties.

Physical indicators are usually obtained by observation or field and laboratory analyses. They include topsoil thickness, bulk density, porosity, aggregate stability, texture, crusting, and compaction. These indicators reflect factors affecting root growth, soil biological activity, seedling emergence, and infiltration and movement of water and air within the soil.

Chemical indicators usually require sampling and field or laboratory analyses. They include measurements of pH, salinity, organic matter, phosphorus concentrations, cation-exchange capacity, and nutrients. The chemical condition of soil affects soil-plant relationships, water quality, buffering capacities, and mobility of nutrients and contaminants.

Biological indicators may be obtained by observation or measurement. They include measurements of micro- and macro-organisms and their activities. Respiration rates to detect microbial decomposition of organic matter and populations of bacteria, fungi, earthworms, nematodes, and mites can be used as biological indicators of soil quality.

Soil quality can be monitored through observation and/or measurement of key soil quality indicators. Soil quality score cards and a test kit (USDA-Soil Quality Institute, 1998) are available to assist in the assessment process. The monitoring program should include several indicators and take into consideration the time of year that sites are monitored, stage of crop

growth, and location within the field where observations are made.

Monitoring soil quality should primarily be used to detect trends that are measurable over a 1- to 10-year period. Monitoring trends determines whether the soil is improving, degrading, or remaining steady under the current management system. This allows land managers to detect problems before undesired and possibly irreversible loss of soil quality occurs.

The local office of the Natural Resources Conservation Service, Soil Conservation District, or Cooperative Extension Service can help establish a plan for monitoring soil quality.

Woodland, Windbreaks and Environmental Plantings

Burke County has approximately 700 acres of native woodland (Jakes and Smith, 1982). This limited woodland is scattered throughout the county with no large concentrations. Most of the upland woodland is found on steep north- and east-facing side slopes and draws on rangeland and pastureland. Trees and shrubs also occur on the fringe of many wetlands in Burke County. The woodland on the woody draws is primarily on areas of Williams loam. The woodland around the wetlands is mostly on a narrow rim of Vallers loam on the outside edge of the wetland. Other woody vegetation consists of scattered shrubs which occur on rangeland.

The dominant upland forest type in Burke County is American elm and green ash. Other trees and shrubs associated with the American elm and green ash include boxelder, bur oak, hawthorn, American plum, chokecherry, golden currant, juneberry, redosier dogwood, Wood's rose, snowberry, and silver buffaloberry. The principal species in the woodland fringe of the wetlands in the county are plains cottonwood, quaking aspen, various willow species, and redosier dogwood. The scattered shrubs found on rangeland consist mostly of silver buffaloberry, common chokecherry, American plum, and western snowberry.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens and furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow tree/shrub rows interspersed with cropland at specified intervals. Field windbreaks oriented perpendicular to the prevailing winds are the most efficient. Intervals depend on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

The following items should be considered before a planting is made: purpose of the planting, suitability of various species of trees and shrubs to the soils and climate, location and design of the windbreak, and selection of hardy seedlings. Planting stock should be from parent material originally from the Northern Great Plains or southern Canadian Prairie provinces. If these items are not considered, a poor, unsuccessful windbreak may result.

Establishment of a windbreak or an environmental planting and growth of trees and shrubs also depends on suitable site preparation and adequate maintenance after the trees and shrubs are planted. Grasses and weeds should be eliminated before the trees and shrubs are planted and competing ground cover should be controlled for the life of the windbreak. Competition from sod-forming grasses will greatly harm and sometimes kill tree and shrub plantings. Some replanting may be necessary during the first two years after the trees and shrubs are planted.

Windbreaks are often planted on land that did not originally support trees. Knowledge of how trees perform on such land can be gained only by observing and recording the performance of trees that have been planted and have survived. Many popular windbreak species are not indigenous to the areas in which they are planted.

Each tree or shrub species has certain climatic and physiographic limits. Within these parameters, a tree or shrub may grow well or grow poorly, depending on the characteristics of the soil.

Windbreak suitability groups consist of soils in which the kinds and degrees of hazards and limitations that affect the survival and growth of trees and shrubs in windbreaks are similar. They are a guide for selecting species best suited for different kinds of soils. Windbreak suitability groups are shown for each soil in Table 9, "Interpretive Groupings Report." They are given for drained conditions and, where applicable, undrained conditions.

Each tree or shrub has definable potential heights in

a given physiographic area and under a given climate. Accurate definitions of potential heights are necessary when a windbreak is planned and designed.

Table 10, "Windbreaks Suitability Groups," shows the height locally grown trees and shrubs are expected to reach in 20 years on various soils. Estimates in this table are based on measurements and observations of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service, the Cooperative Extension Service, or from a nursery.

Windbreak Suitability Groups

The following paragraphs describe the windbreak suitability groups.

Group 1. These are very deep, well to somewhat poorly drained soils that receive beneficial moisture from favorable landscape positions, flooding, or runoff from adjacent land. They may also have a beneficial seasonally high water table during the spring. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species.

Group 1K. These are very deep, calcareous, well to somewhat poorly drained soils on low rises near wetlands that receive beneficial moisture from favorable landscape positions or have a beneficial seasonally high water table during the spring. High calcium carbonate content will have an effect on the selection of species on soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Occasionally, somewhat poorly drained soils may have excessive water for some species. Wind erosion is a concern on these soils.

Group 2. Soils in this group are very deep, poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an affect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on the sandy and organic soils in this group.

Group 2H. Soils in this group are very deep, have an organic mat about 24 inches thick, are poorly or very poorly drained and excessively wet or ponded during the spring or overflow periods. Wetness and drainage will have an affect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 2K. Soils in this group are very deep, calcareous, poorly or very poorly drained, on rims of potholes and broad flats that are excessively wet or ponded during the spring or overflow periods. Wetness, high calcium carbonate content, and drainage will have an affect on the selection of tree and shrub species for soils in this group. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs. Spring planting may be delayed because of wet conditions. Wind erosion is a concern on these soils.

Group 3. Soils in this group are very deep, well drained, loamy textured soils with moderate and moderately slow saturated hydraulic conductivity on uplands. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4. Soils in this group are moderately deep to very deep, have loamy surface textures with clayey subsoils, have slow or very slow saturated hydraulic conductivity, and occur on uplands. High clay content has an affect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas.

Group 4C. Soils in this group are moderately deep to very deep, clayey throughout, have slow or very slow saturated hydraulic conductivity, and occur on uplands. High clay content has an affect on the selection of tree and shrub species for these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on the gently sloping to moderately steep areas.

Group 5. Soils in this group are very deep with loamy and sandy textures. This group typically includes soils that normally have adequate soil moisture. Competition from grass and weeds and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils.

Group 6D. Soils in this group are well drained, mostly loamy textured, and moderately deep over bedrock and other cemented layers that can severely restrict root growth. They have low or moderate available water capacity. Droughtiness will have an affect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 6G. Soils in this group are well drained, mostly loamy textured, and moderately deep over sand and gravel. The sand and gravel can restrict root growth and reduce available water capacity. Droughtiness will have an affect on the selection of tree and shrub species for use on these soils. Competition from grass and weeds is the principal concern in establishing and managing trees and shrubs on these soils. Water erosion is a concern on the gently sloping to moderately steep areas. Supplemental watering may be needed for establishment.

Group 7. Soils in this group are very deep, excessively to moderately well drained, and sandy textured. They typically have low to very low available water capacity and do not normally have adequate moisture. Drought conditions and abrasion from wind erosion are the principal concerns in establishing and managing trees and shrubs on these soils. Specialized site preparation and planting methods (vegetation between the rows is normally left undisturbed) are needed to establish trees and shrubs. Supplemental watering may be essential for successful establishment.

Group 8. Soils in this group are calcareous at or near the surface. They do not receive beneficial moisture from run-on, flooding, or seasonal high water tables. High calcium carbonate content and competition from grass and weeds are the principal concerns in establishing and managing trees and shrubs on these soils. Wind erosion is a concern on these soils and water erosion is a concern on gently sloping to moderately steep areas.

Group 9C. Soils in this group are clayey and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 9L. Soils in this group are loamy and affected by salinity and/or sodicity. These soils do not have a seasonal high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 9W. Soils in this group are affected by salinity and/or sodicity and have a high water table. Concentrations of salt will severely affect the establishment, vigor, and growth of trees and shrubs on these soils.

Group 10. Soils in this group have one or more characteristics such as soil depth, texture, drainage, channeled phases, available water capacity, slope, or salt toxicity which severely limit planting, survival, or growth of trees and shrubs. Soils in this group are usually not recommended for farmstead and feedlot windbreaks, field windbreaks, and plantings for recreation and wildlife. However, onsite investigations may reveal tree and shrub plantings can be made with special treatments (hand planting, no-till planting, scalp planting, specialized site preparation, drainage, or other specialized treatments). Selection of species must be tailored to soil conditions existing at each site.

All soils on moderately steep, steep, or very steep slopes (generally 15 percent or greater) and soils that are generally too wet, too shallow, or have other severely restrictive conditions fall into group 10. When an onsite investigation reveals a planting can be made on a soil in group 10, species should be selected from the most comparable windbreak suitability group. For example, for a shallow soil over bedrock, trees or shrubs would be selected from group 6D; an excessively wet soil would most closely match group 2.

Table 6.-Potential Cropland Limitations and Hazards

(See text for a description and criteria of the limitations and hazards listed in this table.)

Map symbol and component name	Cropland limitations and hazards
110:	
Barnes	None
111:	
Barnes	Pesticide and nutrient runoff
120:	
Barnes	Pesticide and nutrient runoff
	Slope
	Water erosion
Buse	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Slope
	Surface crusting
	Water erosion
	Wind erosion
470:	
Cresbard	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Restricted saturated hydraulic conductivity
	Root limiting
Barnes	None
674:	
Farnuf	None
676:	
Farnuf	Pesticide and nutrient runoff
Sakakawea	Alkalinity
	Lime content
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
882:	
Hamerly	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Surface crusting
	Wind erosion
Tonka	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Restricted saturated hydraulic conductivity
975:	
Heil	High sodium content
	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
	Salt content
	Surface crusting

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
1267:	
Marysland	Alkalinity
	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Surface crusting
	Wind erosion
1427:	
Parnell	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Poor tilth and compaction
	Restricted saturated hydraulic conductivity
1439:	
Parshall	Excessive saturated hydraulic conductivity
	Limited available water capacity
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Wind erosion
1466:	
Pits, sand and gravel	Alkalinity
	Depth to sand and gravel
	Excessive saturated hydraulic conductivity
	Lime content
	Limited available water capacity
	Limited organic matter
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Slope
	Surface rock fragments
	Water erosion
1709:	
Southam	Alkalinity
	High water table
	Lime content
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Restricted saturated hydraulic conductivity
	Salt content
	Surface crusting
	Wind erosion
1739:	
Straw	Pesticide and nutrient leaching
1835:	
Tonka	High water table
	Pesticide and nutrient leaching
	Pesticide and nutrient runoff
	Ponding
	Restricted saturated hydraulic conductivity

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
1871:	
Vallers, saline	Alkalinity High water table Lime content Pesticide and nutrient leaching Salt content Surface crusting Wind erosion
1883:	
Vallers	Alkalinity High water table Lime content Pesticide and nutrient leaching Surface crusting Wind erosion
Parnell	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Poor tilth and compaction Restricted saturated hydraulic conductivity
1978:	
Water	Onsite required
2014:	
Williams	None
Bowbells	Pesticide and nutrient leaching
2015:	
Williams	Pesticide and nutrient runoff
Bowbells	Pesticide and nutrient leaching Pesticide and nutrient runoff
2023:	
Williams	None
Niobell	Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Root limiting
2024:	
Williams	Pesticide and nutrient runoff
Niobell	Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Root limiting
2031:	
Williams	Pesticide and nutrient runoff
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Surface crusting Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2081:	
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Williams	Pesticide and nutrient runoff Slope Water erosion
2130:	
Williams	Pesticide and nutrient runoff Slope Water erosion
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Parnell	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Poor tilth and compaction Restricted saturated hydraulic conductivity
2131:	
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Williams	Pesticide and nutrient runoff Slope Water erosion
Parnell	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Poor tilth and compaction Restricted saturated hydraulic conductivity
2169:	
Harriet	Alkalinity Flooding High sodium content High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2169:(cont.)	
Regan	Alkalinity High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Salt content Surface crusting Wind erosion
Stirum	Alkalinity Excessive saturated hydraulic conductivity Flooding High sodium content High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting Wind erosion
2170:	
Divide	Alkalinity Depth to sand and gravel Excessive saturated hydraulic conductivity High water table Lime content Pesticide and nutrient leaching Surface crusting Wind erosion
2171:	
Sakakawea	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Farnuf	Pesticide and nutrient runoff Slope Water erosion
2172:	
Sakakawea	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Farnuf	Pesticide and nutrient runoff Slope Water erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2173:	
Marias	Alkalinity Limited available water capacity Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Wind erosion
2174:	
Marias	Alkalinity Limited available water capacity Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Water erosion Wind erosion
2175:	
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Williams	Pesticide and nutrient runoff Slope Water erosion
2176:	
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Williams	Pesticide and nutrient runoff Slope Water erosion
2177:	
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Williams	Pesticide and nutrient runoff Slope Water erosion
Vallers	Alkalinity High water table Lime content Pesticide and nutrient leaching Pesticide and nutrient runoff Surface crusting Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2178:	
Farnuf	None
Alkabo	Pesticide and nutrient runoff Root limiting
2179:	
Noonan	High sodium content Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Surface crusting
Niobell	Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Root limiting
2180:	
Niobell	Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Root limiting
Noonan	High sodium content Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Surface crusting
Tonka	High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Restricted saturated hydraulic conductivity
2181:	
Miranda	High sodium content High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Salt content Surface crusting
Noonan	High sodium content Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Surface crusting
2182:	
Portal	Excessive saturated hydraulic conductivity High sodium content Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Poor tilth and compaction Restricted saturated hydraulic conductivity Surface crusting Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2182:(cont.)	
Lihen	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
2183:	
Lihen	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion
Blanchard	Excessive saturated hydraulic conductivity Limited available water capacity Limited organic matter Pesticide and nutrient leaching Wind erosion
2184:	
Williams	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Pesticide and nutrient runoff Wind erosion
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Surface crusting Wind erosion
2185:	
Williams	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Pesticide and nutrient runoff Slope Water erosion Wind erosion
Zahl	Alkalinity Lime content Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Lihen	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Slope Water erosion Wind erosion
2186:	
Lehr	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching
Wabek	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2187:	
Appam	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Wind erosion
Wabek	Alkalinity Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Surface crusting Wind erosion
2188:	
Wabek	Alkalinity Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Surface crusting Wind erosion
Lehr	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff
2189:	
Wabek	Alkalinity Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Slope Surface crusting Water erosion Wind erosion
Appam	Depth to sand and gravel Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Pesticide and nutrient runoff Slope Water erosion Wind erosion
2190:	
Williams	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Wind erosion
2191:	
Towner	Excessive saturated hydraulic conductivity Limited available water capacity Pesticide and nutrient leaching Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2191:(cont.)	
Kratka	Excessive saturated hydraulic conductivity High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Wind erosion
2192:	
Kratka	Excessive saturated hydraulic conductivity High water table Pesticide and nutrient leaching Pesticide and nutrient runoff Ponding Wind erosion
Wyndmere	Alkalinity Excessive saturated hydraulic conductivity High water table Lime content Pesticide and nutrient leaching Surface crusting Wind erosion
2193:	
Dumps, mine	Alkalinity Dense layer High sodium content Lime content Limited available water capacity Limited organic matter Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Salt content Slope Surface crusting Water erosion Wind erosion
Ustorthents	Alkalinity Dense layer Lime content Limited available water capacity Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Slope Surface crusting Water erosion Wind erosion
2194:	
Haplustolls	Dense layer Lime content Limited available water capacity Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Surface crusting Wind erosion

Table 6.-Potential Cropland Limitations and Hazards--Continued

Map symbol and component name	Cropland limitations and hazards
2194:(cont.)	
Ustorthents	Alkalinity Dense layer Lime content Limited available water capacity Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Surface crusting Water erosion Wind erosion
2195:	
Ustorthents	Alkalinity Dense layer Lime content Limited available water capacity Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Slope Surface crusting Water erosion Wind erosion
Haplustolls	Dense layer Lime content Limited available water capacity Pesticide and nutrient runoff Restricted saturated hydraulic conductivity Slope Surface crusting Water erosion Wind erosion
2227:	
Swenoda	Excessive saturated hydraulic conductivity Pesticide and nutrient leaching Wind erosion

Table 7.-Map Unit Productivity Index and Farmland Designation

(Dashes (—) indicate an assignment has not been made. Entries in () are for undrained conditions.)

Map symbol	Spring wheat productivity index	Farmland designation
110	85	Prime farmland
111	75	Prime farmland
120	56	Other land
470	84	Farmland of statewide importance
674	87	Farmland of statewide importance
676	77	Farmland of statewide importance
882	82(61)	Prime farmland if drained
975	29	Other land
1267	57(32)	Prime farmland if drained
1427	69(23)	Other land
1439	68	Farmland of statewide importance
1466	11	Other land
1709	51(5)	Other land
1739	90	Prime farmland
1835	80(44)	Prime farmland if drained
1871	36(36)	Other land
1883	72(37)	Other land
1978	0	Other land
2014	90	Farmland of statewide importance
2015	87	Farmland of statewide importance
2023	80	Farmland of statewide importance
2024	76	Farmland of statewide importance
2031	76	Farmland of statewide importance
2081	45	Other land
2130	66(57)	Farmland of statewide importance
2131	45(30)	Other land
2169	26	Other land
2170	60	Farmland of statewide importance
2171	58	Farmland of statewide importance
2172	34	Other land
2173	88	Farmland of statewide importance

Table 7.-Map Unit Productivity Index and Farmland Designation--Continued

Map symbol	Spring wheat productivity index	Farmland designation
2174	82	Farmland of statewide importance
2175	60	Farmland of statewide importance
2176	29	Other land
2177	33	Other land
2178	80	Farmland of statewide importance
2179	56	Other land
2180	67(50)	Other land
2181	40	Other land
2182	53	Other land
2183	45	Other land
2184	71	Farmland of statewide importance
2185	46	Other land
2186	46	Other land
2187	43	Other land
2188	35	Other land
2189	21	Other land
2190	78	Other land
2191	66(56)	Other land
2192	68(43)	Prime farmland if drained
2193	10	Other land
2194	64	Farmland of statewide importance
2195	42	Other land
2227	73	Prime farmland

Table 8.-Yields per Acre of Crops

(Yield estimates are those that can be expected under a high level of management. They are for nonirrigated areas. The presence of yield information does not indicate the soil is suited for cultivated crops. Absence of yield information indicates that the soil is not rated. Entries in () are for undrained conditions.)

Map symbol and soil name	Spring wheat	Oats	Barley	Sunflowers	Grass-alfalfa hay *
	Bu	Bu	Bu	Lbs	T/A
110: Barnes	35	74	57	1,740	2.3
111: Barnes	31	65	50	1,540	2.0
120: Barnes-Buse	23	49	37	1,150	1.5
470: Cresbard-Barnes	34	73	56	1,720	2.2
674: Farnuf	36	76	58	1,790	2.3
676: Farnuf-Sakakawea	32	67	51	1,580	2.1
882: Hamerly-Tonka	34(25)	71(53)	55(41)	1,680(1,250)	2.3(2.5)
975: Heil	12	25	19	600	1.4
1267: Marysland	23(13)	50(28)	38(21)	1,170(660)	2.3(2.7)
1427: Parnell	28(9)	60(15)	46(15)	1,420(472)	2.7(0.5)
1439: Parshall	28	60	45	1,390	2.7
1466: Pits, sand and gravel	5	10	7	230	0.3
1709: Southam	21(2)	44(4)	34(3)	1,050(100)	2.0(0.1)
1739: Straw	37	78	60	1,850	2.4
1835: Tonka	33(18)	70(38)	53(29)	1,640(900)	2.8(2.8)
1871: Vallers, saline	15(15)	31(31)	24(24)	740(740)	1.8(1.8)
1883: Vallers-Parnell	30(15)	63(32)	48(25)	1,480(760)	2.5(2.0)
1978: Water	—	—	—	—	—

Table 8.-Yields per Acre of Crops--Continued

Map symbol and soil name	Spring wheat	Oats	Barley	Sunflowers	Grass-alfalfa hay *
	Bu	Bu	Bu	Lbs	T/A
2014: Williams-Bowbells	37	78	60	1,850	2.4
2015: Williams-Bowbells	36	76	58	1,780	2.3
2023: Williams-Niobell	33	70	53	1,640	2.1
2024: Williams-Niobell	31	66	51	1,560	2.0
2031: Williams-Zahl	31	66	51	1,560	2.0
2081: Zahl-Williams	18	39	30	930	1.2
2130: Williams-Zahl-Parnell	27(23)	58(50)	44(38)	1,350(1,170)	1.8(1.5)
2131: Zahl-Williams-Parnell	18(12)	39(26)	30(20)	920(620)	1.2(0.8)
2169: Harriet, Regan & Stirum	11	23	17	530	1.6
2170: Divide	25	52	40	1,230	2.3
2171: Sakakawea-Farnuf	24	51	39	1,190	1.5
2172: Sakakawea-Farnuf	14	30	23	700	0.9
2173: Marias	36	77	59	1,800	2.3
2174: Marias	34	71	55	1,680	2.2
2175: Zahl-Williams	25	52	40	1,230	1.6
2176: Zahl-Williams	12	25	19	600	0.8
2177: Zahl-Williams-Vallers	14	29	22	680	0.9
2178: Farnuf-Alkabo	33	70	53	1,640	2.1
2179: Noonan-Niobell	23	49	37	1,150	1.5
2180: Niobell-Noonan-Tonka	27(21)	58(44)	45(33)	1,370(1,025)	2.1(2.0)
2181: Miranda-Noonan	16	35	27	820	1.1

Table 8.-Yields per Acre of Crops--Continued

Map symbol and soil name	Spring wheat	Oats	Barley	Sunflowers	Grass-alfalfa hay *
	Bu	Bu	Bu	Lbs	T/A
2182:-------------------- Portal-Lihen	22	46	35	1,090	1.4
2183:-------------------- Lihen-Blanchard	18	39	30	920	1.2
2184:-------------------- Williams-Zahl	29	62	47	1,460	1.9
2185:-------------------- Williams-Zahl-Lihen	19	40	31	940	1.2
2186:-------------------- Lehr-Wabek	19	40	31	940	1.2
2187:-------------------- Appam-Wabek	18	37	29	880	1.1
2188:-------------------- Wabek-Lehr	14	30	23	720	0.9
2189:-------------------- Wabek-Appam	9	18	14	430	0.6
2190:-------------------- Williams	32	68	52	1,600	2.1
2191:-------------------- Towner-Kratka	27(23)	58(49)	44(37)	1,350(1,150)	2.1(2.1)
2192:-------------------- Kratka-Wyndmere	28(18)	59(37)	45(29)	1,390(880)	2.4(2.5)
2193:-------------------- Dumps, mine-Ustorthents	4	9	7	210	0.6
2194:-------------------- Haplustolls-Ustorthents	26	56	43	1,310	1.7
2195:-------------------- Ustorthents-Haplustolls	17	37	28	860	1.1
2227:-------------------- Swenoda	30	64	49	1,500	1.9

* Yield estimates for adapted species.

Table 9.-Interpretive Groupings Report

(Dashes (—) indicate an interpretive group is not assigned. Entries in () are for undrained conditions.)

Map symbol and soil name	Pasture and hayland group	Land capability class	Windbreak suitability group
110:			
Barnes----------	Loamy and Silty A1	2c	3
111:			
Barnes----------	Loamy and Silty A1	2e	3
120:			
Barnes----------	Loamy and Silty A1	3e	3
Buse------------	Thin Upland A2	4e	8
470:			
Cresbard--------	Clayey Subsoils F1	2s	4
Barnes----------	Loamy and Silty A1	2c	3
674:			
Farnuf----------	Loamy and Silty A1	2c	3
676:			
Farnuf----------	Loamy and Silty A1	2e	3
Sakakawea-------	Thin Upland A2	3e	8
882:			
Hamerly---------	Limy Subirrigated A5	2e	1K
Tonka-----------	Overflow and Run-on A3 (Wet C1)	2w(4w)	1(2)
975:			
Heil------------	Sodic-Saline G3	6s	10
1267:			
Marysland-------	Limy Subirrigated A5 (Wet C1)	2w(4w)	1K(2K)
1427:			
Parnell---------	Wet C1 (Wetland H6)	3w(5w)	2(10)
1439:			
Parshall--------	Sandy A6	3e	5
1466:			
Pits, sand and gravel---------	—	8	10
1709:			
Southam---------	Wet C1 (Wetland H6)	3w(8)	2K(10)
1739:			
Straw-----------	Loamy and Silty A1	2c	1
1835:			
Tonka-----------	Overflow and Run-on A3 (Wet C1)	2w(4w)	1(2)
1871:			
Vallers, saline-	Saline G4	3s	9W

Table 9.-Interpretive Groupings Report--Continued

Map symbol and soil name	Pasture and hayland group	Land capability class	Windbreak suitability group
1883:			
Vallers	Limy Subirrigated A5 (Wet C1)	2w(4w)	1K(2K)
Parnell	Wet C1 (Wetland H6)	3w(5w)	2(10)
1978:			
Water	—	—	
2014:			
Williams	Loamy and Silty A1	2c	3
Bowbells	Overflow and Run-On A3	2c	1
2015:			
Williams	Loamy and Silty A1	2e	3
Bowbells	Overflow and Run-On A3	2e	1
2023:			
Williams	Loamy and Silty A1	2c	3
Niobell	Loamy and Silty A1	2s	3
2024:			
Williams	Loamy and Silty A1	2e	3
Niobell	Loamy and Silty A1	2e	3
2031:			
Williams	Loamy and Silty A1	2e	3
Zahl	Thin Upland A2	3e	8
2081:			
Zahl	Thin Upland A2	6e	10
Williams	Loamy and Silty A1	4e	3
2130:			
Williams	Loamy and Silty A1	3e	3
Zahl	Thin Upland A2	4e	8
Parnell	Wet C1 (Wetland H6)	3w(5w)	2(10)
2131:			
Zahl	Steeply Sloping H3	7e	10
Williams	Loamy and Silty A1	6e	3
Parnell	Wet C1 (Wetland H6)	3w(5w)	2(10)
2169:			
Harriet	Sodic-Saline G3	6s	10
Regan	Saline G4	4w	2K
Stirum	Sodic-Saline G3	6s	10
2170:			
Divide	Limy Subirrigated A5	2s	1K

Table 9.-Interpretive Groupings Report--Continued

Map symbol and soil name	Pasture and hayland group	Land capability class	Windbreak suitability group
2171:			
Sakakawea-------	Thin Upland A2	4e	8
Farnuf----------	Loamy and Silty A1	3e	3
2172:			
Sakakawea-------	Thin Upland A2	6e	10
Farnuf----------	Loamy and Silty A1	4e	3
2173:			
Marias----------	Clayey A4	2e	4C
2174:			
Marias----------	Clayey A4	2e	4C
2175:			
Zahl------------	Thin Upland A2	4e	8
Williams--------	Loamy and Silty A1	3e	3
2176:			
Zahl------------	Steeply Sloping H3	7e	10
Williams--------	Steeply Sloping H3	7e	10
2177:			
Zahl------------	Steeply Sloping H3	7e	10
Williams--------	Steeply Sloping H3	7e	10
Vallers---------	Limy Subirrigated A5 (Wet C1)	2w(4w)	1K(2K)
2178:			
Farnuf----------	Loamy and Silty A1	2c	3
Alkabo----------	Loamy and Silty A1	2s	3
2179:			
Noonan----------	Claypan G1	4s	9L
Niobell---------	Loamy and Silty A1	2e	3
2180:			
Niobell---------	Loamy and Silty A1	2s	3
Noonan----------	Claypan G1	4s	9L
Tonka-----------	Overflow and Run-On A3 (Wet C1)	2w(4w)	1(2)
2181:			
Miranda---------	Thin Claypan G2	6s	10
Noonan----------	Claypan G1	4s	9L
2182:			
Portal----------	Claypan G1	4s	9L
Lihen-----------	Sands A7	4e	7

Table 9.-Interpretive Groupings Report--Continued

Map symbol and soil name	Pasture and hayland group	Land capability class	Windbreak suitability group
2183:			
Lihen-----------	Sands A7	4e	7
Blanchard-------	Sands A7	6e	10
2184:			
Williams--------	Loamy and Silty A1	3e	3
Zahl------------	Thin Upland A2	3e	8
2185:			
Williams--------	Loamy and Silty A1	4e	3
Zahl------------	Thin Upland A2	6e	10
Lihen-----------	Sandy A6	6e	5
2186:			
Lehr------------	Shallow to Gravel B1	3e	6G
Wabek-----------	Very Shallow to Gravel B2	6s	10
2187:			
Appam-----------	Shallow to Gravel B1	3e	6G
Wabek-----------	Very Shallow to Gravel B2	6s	10
2188:			
Wabek-----------	Very Shallow to Gravel B2	6s	10
Lehr------------	Shallow to Gravel B1	3e	6G
2189:			
Wabek-----------	Very Shallow to Gravel B2	7s	10
Appam-----------	Shallow to Gravel B1	6e	6G
2190:			
Williams--------	Loamy and Silty A1	3e	3
2191:			
Towner----------	Sands A7	4e	5
Kratka----------	Wet C1	3w(4w)	1(2)
2192:			
Kratka----------	Wet C1	3w(4w)	1(2)
Wyndmere--------	Limy Subirrigated A5	3e	1K
2193:			
Dumps, mine-----	—	8s	10
Ustorthents ----	Thin Upland A2	7e	8
2194:			
Haplustolls-----	Loamy and Silty A1	3e	3
Ustorthents-----	Thin Upland A2	4e	8

Table 9.-Interpretive Groupings Report--Continued

Map symbol and soil name	Pasture and hayland group	Land capability class	Windbreak suitability group
2195:			
Ustorthents-----	Thin Upland A2	6e	8
Haplustolls-----	Loamy and Silty A1	4e	3
2227:			
Swenoda---------	Sandy A6	3e	1

Table 10.—Windbreak Suitability Groups

Expected Shrub Heights at 20 Years

(Dashes (—) indicate the species are not expected to perform adequately on these suitability groups under most conditions.)

Species	Windbreak suitability groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-6	3-4	3-5	3-4	—	4-6
Buffaloberry, Silver	8-12	8-12	—	—	—	9-12
Caragana (Peashrub, Siberian)	8-10	8-10	7-8	—	—	8-10
Cherry, Europian Bird (Mayday)	10-15	—	10-15	—	—	10-12
Cherry, Nanking	6-8	—	4-6	—	—	5-7
Cherry, Mongolian	5-6	—	4-6	—	—	4-6
Cherry, Western Sand	4-6	—	—	—	—	4-6
Cotoneaster, Peking	8-10	7-9	8-10	—	—	7-9
Cotoneaster, Europian	10-12	9-11	8-12	—	—	7-9
Currant, Golden	5-7	—	4-6	—	—	5-6
Dogwood, Redosier	6-8	—	6-8	—	—	5-7
Forsythia, ‘Meadowlark’	7-11	6-8	—	—	—	7-9
Honeysuckle, Amur	8-10	7-9	—	—	—	7-9
Honeysuckle, Blueleaf ‘Freedom	8-10	7-9	—	—	—	7-9
Honeysuckle, Tatarian	7-9	6-8	—	—	—	6-8
Indigo, False	6-8	5-7	6-8	6-8	—	4-6
Juneberry (Serviceberry)	5-6	—	5-6	—	—	5-6
Lilac, Common	8-10	8-10	6-8	6-8	—	7-9
Lilac, Late	8-10	6-8	8-10	6-8	—	7-9
Plum, American	5-8	—	5-6	—	—	6-8
Rose, Species	4-5	4-5	4-5	—	—	4-5
Sea-buckthorn	9-11	9-11	—	—	—	7-9
Silverberry	4-8	4-6	—	—	—	5-7
Sumac, Skunkbush	3-9	3-7	3-8	—	—	5-9
Willow, Sandbar	5-6	4-5	5-7	4-5	—	5-6
Viburnum, Nannyberry	10-14	—	10-12	—	—	8-10

Table 10.—Windbreak Suitability Groups--Continued

Expected Shrub Heights at 20 Years

Species	Windbreak suitability groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Almond, Russian	4-5	4-5	3-4	—	—	—
Buffaloberry, Silver	7-8	7-8	4-7	4-6	4-6	—
Caragana (Peashrub, Siberian)	7-8	5-6	7-9	6-8	6-8	—
Cherry, Europian Bird (Mayday)	10-12	8-10	8-10	6-8	4-6	—
Cherry, Nanking	4-5	4-5	4-5	—	—	—
Cherry, Mongolian	4-6	4-6	4-5	—	—	—
Cherry, Western Sand	—	—	4-6	3-5	3-5	—
Cotoneaster, Peking	6-7	5-7	6-7	—	—	—
Cotoneaster, Europian	9-10	8-9	8-10	—	—	—
Currant, Golden	3-5	3-5	5-6	—	—	—
Dogwood, Redosier	4-6	4-6	—	—	—	—
Forsythia, 'Meadowlark'	—	—	6-8	—	—	—
Honeysuckle, Amur	7-9	7-9	6-8	—	—	—
Honeysuckle, Blueleaf 'Freedom	7-9	7-9	6-8	5-7	5-7	—
Honeysuckle, Tatarian	6-8	6-8	5-7	4-6	4-6	—
Indigo, False	—	—	—	—	—	—
Juneberry (Serviceberry)	4-5	4-5	—	—	—	—
Lilac, Common	5-7	4-6	6-8	4-6	4-6	—
Lilac, Late	6-8	6-8	—	—	—	—
Plum, American	5-7	5-7	4-6	—	—	—
Rose, Species	4-5	3-4	3-4	2-4	2-4	—
Sea-buckthorn	7-9	7-9	6-8	5-7	5-7	—
Silverberry	—	—	5-7	4-6	4-6	—
Sumac, Skunkbush	3-5	3-5	5-9	6-7	6-7	—
Willow, Sandbar	4-5	4-5	—	—	—	—
Viburnum, Nannyberry	—	—	6-8	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Shrub Heights at 20 Years

Species	Windbreak suitability groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Almond, Russian	—	—	—	—	—
Buffaloberry, Silver	4-5	4-5	—	4-5	—
Caragana (Peashrub, Siberian)	4-5	4-5	—	4-5	
Cherry, Europian Bird (Mayday)	—	—	—	—	-
Cherry, Nanking	—	—	—	—	—
Cherry, Mongolian	—	—	—	—	—
Cherry, Western Sand	—	—	—	—	-
Cotoneaster, Peking	—	—	—	—	—
Cotoneaster, Europian	—	—	—	—	—
Currant, Golden	—	3-4	3-4	3-4	—
Dogwood, Redosier	—	—	—	—	—
Forsythia, ‘Meadowlark’	—	—	—	—	—
Honeysuckle, Amur	—	—	—	—	—
Honeysuckle, Blueleaf ‘Freedom	4-5	4-5	—	4-5	-
Honeysuckle, Tatarian	4-5	4-5	—	4-5	-
Indigo, False	—	—	—	—	—
Juneberry, (Serviceberry)	—	—	—	—	—
Lilac, Common	4-5	4-5	—	4-5	—
Lilac, Late	—	—	—	—	—
Plum, American	—	—	—	—	—
Rose, Species	—	—	—	—	-
Sea-buckthorn	4-5	4-5	—	4-5	-
Silverberry	3-5	3-5	—	3-5	-
Sumac, Skunkbush	3-4	3-4	—	3-4	-
Willow, Sandbar	—	—	—	—	—
Viburnum, Nannyberry	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Heights at 20 Years

Species	Windbreak suitability groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	14-16	-	14-16	—	—	15-17
Ash, Black	18-20	16-18	16-18	16-18	—	16-18
Ash, Green	18-22	16-20	18-22	16-20	—	17-21
Aspen, Quaking	25-30	20-25	25-30	25-30	—	—
Boxelder	15-18	—	16-18	—	—	-
Chokecherry, Common	10-12	8-10	8-10	6-8	—	8-10
Cottonwood, Species	38-46	34-42	36-44	30-40	—	—
Crabapple, Species	17-18	—	15-16	—	—	17-18
Elm, Japanese	25-30	20-25	—	—	—	25-30
Elm, Siberian	24-30	24-30	24-30	24-30	—	22-27
Hackberry, Common	18-22	16-20	18-22	16-20	—	17-21
Hawthorn, Arnold	10-12	8-10	8-10	6-8	—	9-11
Hawthorn, Downy	10-12	8-10	8-10	6-8	—	9-11
Maple, Amur	10-12	—	7-10	—	—	9-10
Maple, Tatarian	10-12	—	7-10	—	—	9-10
Oak, Bur	17-20	15-18	—	—	—	17-20
Olive, Russian	15-18	15-18	15-18	15-18	—	14-17
Pear, Ussurian(Harbin)	15-17	—	13-15	—	—	15-17
Poplar, Hybrid Species	40-45	—	35-40	—	—	—
Poplar, White	28-35	28-30	28-30	28-30	—	20-25
Willow, Laurel	20-25	15-20	20-25	15-20	15-20	—
Willow, White	20-25	15-20	20-25	15-20	15-20	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Heights at 20 Years

Species	Windbreak Suitability Groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—	—
Ash, Black	—	—	—	—	—	—
Ash, Green	15-17	15-17	13-16	12-15	12-15	—
Aspen, Quaking	—	—	—	—	—	—
Boxelder	—	—	—	—	—	—
Chokecherry, Common	7-9	6-8	6-8	6-8	6-8	—
Cottonwood, Species	—	—	—	—	—	—
Crabapple, Species	10-12	10-12	10-12	—	—	—
Elm, Japanese	20-25	20-25	20-25	18-20	18-20	—
Elm, Siberian	18-20	18-20	18-20	16-20	16-20	—
Hackberry, Common	15-17	15-17	13-15	—	—	—
Hawthorn, Arnold	7-9	7-9	8-10	6-8	6-8	—
Hawthorn, Downy	7-9	7-9	8-10	6-8	6-8	—
Maple, Amur	—	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—	—
Oak, Bur	13-15	13-15	12-15	—	—	—
Olive, Russian	12-14	12-14	12-15	10-12	10-12	—
Pear, Ussurian(Harbin)	10-12	10-12	10-12	—	—	—
Poplar, Hybrid Species	—	—	—	—	—	—
Poplar, White	—	—	—	—	—	—
Willow, Laurel	—	—	—	—	—	-
Willow, White	—	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Deciduous Heights at 20 Years

Species	Windbreak suitability groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Apricot, Species	—	—	—	—	—
Ash, Black	—	—	—	—	—
Ash, Green	8-9	8-10	8-9	8-12	—
Aspen, Quaking	—	—	—	—	—
Boxelder	—	—	—	—	—
Chokecherry, Common	—	—	—	—	—
Cottonwood, Species	—	—	—	—	—
Crabapple, Species	—	—	—	—	—
Elm, Japanese	15-18	10-15	—	10-15	—
Elm, Siberian	10-12	9-11	—	9-11	—
Hackberry, Common	—	—	—	—	—
Hawthorn, Arnold	—	—	—	—	—
Hawthorn, Downy	—	—	—	—	—
Maple, Amur	—	—	—	—	—
Maple, Tatarian	—	—	—	—	—
Oak, Bur	—	—	—	—	—
Olive, Russian	8-9	6-8	6-8	8-10	—
Pear, Ussurian(Harbin)	8-9	—	—	—	-
Poplar, Hybrid Species	—	—	—	—	—
Poplar, White	—	—	—	—	—
Willow, Laurel	—	—	—	—	—
Willow, White	—	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights at 20 Years

Species	Windbreak suitability groups					
	1	1K	2	2K	2H	3
	ft.	ft.	ft.	ft.	ft.	ft.
Juniper, Rocky Mountain	10-12	-	10-12	-	—	10-12
Larch, Siberian	16-20	—	—	—	—	15-19
Pine, Ponderosa	16-20	14-16	16-20	—	—	16-20
Pine, Scotch	14-16	—	14-16	—	—	14-16
Redcedar, Eastern	10-12	-	10-12	-	—	10-12
Spruce, Black Hills	16-20	—	14-18	—	—	15-19
Spruce, Colorado Blue	16-20	—	14-18	—	—	15-19

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights at 20 Years

Species	Windbreak suitability groups					
	4	4C	5	6D	6G	7
	ft.	ft.	ft.	ft.	ft.	ft.
Juniper, Rocky Mountain	9-11	9-11	9-12	8-10	8-10	7-9
Larch, Siberian	—	—	14-18	—	—	—
Pine, Ponderosa	14-15	14-15	16-20	11-14	11-14	11-14
Pine, Scotch	—	—	—	—	—	—
Redcedar, Eastern	9-11	9-11	9-12	8-10	8-10	7-9
Spruce, Black Hills	12-14	12-14	—	—	—	—
Spruce, Colorado Blue	12-14	12-14	—	—	—	—

Table 10.—Windbreak Suitability Groups--Continued

Expected Conifer Heights at 20 Years

Species	Windbreak suitability groups				
	8	9C	9W	9L	10
	ft.	ft.	ft.	ft.	ft.
Juniper, Rocky Mountain	6-8	6-7	5-6	6-7	—
Larch, Siberian	—	—	—	—	—
Pine, Ponderosa	11-14	8-10	—	8-10	—
Pine, Scotch	—	—	—	—	—
Redcedar, Eastern	6-8	6-7	5-6	6-7	—
Spruce, Black Hills	—	—	—	—	—
Spruce, Colorado Blue	—	—	—	—	—

Rangeland

Rangeland makes up about 238,000 acres or about 33 percent of the land in Burke County. This rangeland is used primarily for grazing by domestic livestock; however, it also provides wildlife habitat, watershed protection, recreational areas, and aesthetic value.

Rangeland is defined as land on which the native vegetation (historic climax, or natural potential plant community) is predominantly grass, grasslike plants, forbs, and shrubs. Rangeland includes natural grasslands, savannas, marshes, and wet meadows. Cultural treatments, such as fertilization and cultivation, generally are not used or needed to maintain productivity of rangeland. The composition and production of the plant community are largely determined by soil, climate, topography, and grazing influences.

Range Sites

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil.

Soils vary in their capacity to produce grasses and other native plants. Soils that produce similar kinds, proportion, and amounts of vegetation are grouped into a range site.

Range Site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. Over time, the combination of plants best suited to a particular soil and climate has become established. In the absence of excessive disturbances, this group of plants is the natural plant community or climax community for the site. Natural plant communities are not static but vary slightly from year to year and place to place. The natural potential plant community is generally, but not always, the most productive and diverse combination of plants that may occur on a site.

The relationship between soils and vegetation was determined during this survey. In most cases, range sites can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range sites. Soil reaction, salt content, and a seasonal high water table are also important. Many different range sites occur in the survey area. Range sites for each map unit component under undrained conditions are given in Table 11, "Range Sites."

The following paragraphs describe soil and landscape features and limitations associated with the range sites in Major Land Resource Area (MLRA) 53A and 53B. Some of the range sites may not occur in Burke County.

Clayey range site. These are very deep, well and moderately well drained, moderately fine and fine textured soils. Saturated hydraulic conductivity is slow or very slow. Available water capacity is high. This site is on nearly level to gently rolling glacial till plains, lake plains, and terraces of large streams. Slope ranges from 1 to 9 percent.

Site retrogression results in a decrease in the abundance of such plants as western wheatgrass, porcupinegrass, green needlegrass, and prairie junegrass. The plants that usually increase under these conditions are needleandthread, blue grama, fringed sagewort, and upland sedges. Further deterioration may result in a dominance of blue grama, upland sedges, western ragweed, and fringed sagewort, and invasion of Kentucky bluegrass.

Very few problems affect management of this site. The water infiltration rate is slow. As a result, an adequate cover of vegetation is needed to help reduce runoff.

Claypan range site. These are very deep, moderately well and well drained soils. They have moderately coarse to moderately fine textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to fine textured and are high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is

moderate. This site is on nearly level to undulating glacial till plains and lake plains. Slope ranges from 0 to 6 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, needleandthread, and western wheatgrass. The plants that tend to increase in abundance under retrogression include inland saltgrass, blue grama, Sandberg bluegrass, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, inland saltgrass, upland sedges, fringed sagewort, broom snakeweed, and annual forbs.

This site is easily damaged by mismanagement. Because of a dense subsoil and the content of salts in the soil, reestablishing the vegetation is difficult in denuded areas. Management that maintains an abundance of the climax species will maintain production and protect the soil from erosion.

Closed Depression range site. These are very deep, poorly drained, fine textured soils. They have a dense sodic suboil that restricts root growth. Saturated hydraulic conductivity is very slow and available water capacity is moderate. The site is on flats and in enclosed depressions of glacial till and residual uplands.

The site is easily damaged by mismanagement. Because of the dense subsoil and the content of salts in the soil, reestablishing vegetation is difficult in denuded areas. Management that maintains an abundance of the climax species will maintain production and protect the quality of the site.

Site retrogression results in a decrease in the abundance of plants such as prairie cordgrass, slender wheatgrass, and common spikesedge. The plants that tend to increase in abundance under these conditions include inland saltgrass and foxtail barley. Western wheatgrass initially increases and then decreases under heavy grazing. Further deterioration may result in a dominance of foxtail barley, inland santgrass, and undesirable forbs.

Limy Subirrigated range site. These are very deep soils that are typically somewhat poorly drained, but include some moderately well drained soils. They have a loamy fine sand to silty clay loam surface layer and typically have a water table at about 1.5 to 3.5 feet during the spring and early summer. These soils have a layer high in lime within 16 inches of the surface. This site is on level, nearly level, and gently sloping glacial lake plains, glacial till plains, and outwash plains. Slope ranges from 0 to 6 percent.

Site retrogression usually results in a decrease in the abundance of such plants as big bluestem, indiangrass, switchgrass, and Maximilian sunflower. Little bluestem usually increases initially in abundance under these conditions, but it eventually decreases with more severe deterioration. Further deterioration results in a dominance of Baltic rush, common spikerush, annual grasses and forbs, and invasion of Kentucky bluegrass.

Generally, no major problems affect management. The dominant warm-season grasses on this site provide high-quality forage and wildlife habitat late in the growing season.

Overflow range site. These are very deep, moderately well and well drained, moderate to moderately fine textured soils that regularly receive additional run-on from surrounding uplands or flooding. Saturated hydraulic conductivity is moderate and available water capacity is high to very high. This site occurs on nearly level swales and depressions on glacial till plains and on stream terraces and flood plains. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of such plants as big bluestem, green needlegrass, prairie dropseed, and switchgrass. The plants that increase in abundance under these conditions are western wheatgrass, blue grama, sun sedge, and fescue sedge. Further deterioration results in a dominance of blue grama and sedges, and invasion of Kentucky bluegrass.

As a result of flooding and the upland runoff received by this site, it is very productive when properly managed.

Saline Lowland range site. These are very deep, somewhat poorly and poorly drained, medium and fine textured saline soils. Also included are some saline-sodic soils. This range site receives additional water from ground water seepage and/or run-on. Surface layers commonly are saline. Saturated hydraulic conductivity is moderate to very slow and available water capacity is moderate. This site occurs on shallow basins and lake plains and on low terraces and bottom lands along streams. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of such plants as Nuttall alkaligrass, slender wheatgrass, and western wheatgrass. The plants that increase in abundance under these conditions are inland saltgrass, alkali muhly, foxtail barley, and mat muhly. Further deterioration results in

a dominance of inland saltgrass, foxtail barley, silverweed cinquefoil, and western dock.

A high content of salts and a moderate available water capacity limit production on this site. Proper management of the adapted salt-tolerant plants will maintain optimum production. If the plant community has been severely damaged, however, the site recovers slowly. Wind and water erosion are hazards in denuded areas. Stockwater ponds on this site frequently contain salty water.

Sands range site. These are very deep, well or excessively drained, coarse textured soils. Saturated hydraulic conductivity is rapid and available water capacity is low to moderate. Soils on this site are highly susceptible to wind erosion. This site is on nearly level to steep outwash and delta plains. Slope ranges from 1 to 35 percent.

Site retrogression generally results in a decrease in the abundance of such plants as prairie sandreed, sand bluestem, and leadplant amorpha. The plants that increase in abundance under these conditions are sand dropseed, blue grama, needleandthread, upland sedges, and forbs. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, fringed sagewort, green sagewort, cudweed sagewort, and prairie rose.

The limited available water capacity and the hazard of wind erosion are concerns in managing this site. In severely disturbed areas, blowouts are common. The vegetation responds rapidly to improved management.

Sandy range site. These are very deep, well drained, moderately coarse textured soils. Saturated hydraulic conductivity is moderately rapid and available water capacity is moderate. These soils are friable and susceptible to wind erosion. This site is on nearly level to rolling glacial till plains, lake plains, and outwash plains. Slope ranges from 1 to 15 percent.

Site retrogression generally results in a decrease in the abundance of such plants as western wheatgrass, green needlegrass, prairie sandreed, and leadplant amorpha. The plants that increase under these conditions are needleandthread, blue grama, upland sedges, sand dropseed, and annual forbs. Further deterioration results in a dominance of blue grama, upland sedges, and forbs, such as western yarrow, green sagewort, and fringed sagewort.

Moderate available water capacity is a concern in managing this site. Also, wind erosion is a hazard in denuded areas. Management that maintains an abundance of the climax species results in a productive natural plant community and provides a good protective plant cover.

Sandy Claypan range site. These are very deep, somewhat poorly drained soils. They have moderately coarse textured surface layers underlain by a sodic subsoil. The subsoils are moderately coarse to medium textured and are high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is low. This site is on nearly level outwash and lake plains. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of such plants as western wheatgrass and needleandthread. The plants that increase in abundance under these conditions are blue grama, upland sedges, and fringed sagewort. Further deterioration results in a dominance of blue grama, upland sedges, fringed sagewort, annual forbs, and annual grasses.

The soils have a dense, sodic subsoil and limited available water capacity. The site is fragile, and the natural plant community can deteriorate rapidly. Management that maintains a protective plant cover will control erosion.

Shallow range site. These are shallow, moderately coarse to moderately fine textured soils overlying weathered bedrock at less than 20 inches. They are well to somewhat excessively drained. Permeability is slow to rapid and available water capacity is low. This site occurs on undulating to very steep uplands. Slope ranges from 6 to over 35 percent.

Low available water capacity limits production on this site. The site is fragile, and the plant community can deteriorate rapidly. The plant community should be kept near its potential and maintained in a high state of vigor in order to optimize use of available moisture.

Site retrogression results in a decrease in the abundance of plants such as little bluestem, needleandthread, western wheatgrass, plains muhly, and prairie sandreed. The plants that increase in abundance under these conditions are blue grama, red threeawn, Kentucky bluegrass, upland sedges, and undesirable forbs. Further deterioration may result in a dominance of blue grama, Kentucky bluegrass, upland sedges, fringed sagewort, and undesirable forbs.

Shallow to Gravel range site. These are shallow, moderately coarse and medium textured soils overlying sand and gravel at about 20 inches. They

are somewhat excessively drained. Saturated hydraulic conductivity is moderate over moderately rapid and available water capacity is low. This site occurs on nearly level to steep outwash plains and stream terraces. Slope ranges from 1 to 25 percent.

Site retrogression results in a decrease in the abundance of such plants as green needlegrass, western wheatgrass, plains muhly, and prairie junegrass. The plants that increase in abundance under these conditions are blue grama, red threeawn, and upland sedges. Further deterioration results in a dominance of blue grama, upland sedges, annual forbs, and fringed sagewort.

Low available water capacity limits production on this site. The site is fragile, and the plant community can deteriorate rapidly. The plant community should be kept near its potential, and maintained in a high state of vigor, in order to optimize use of available moisture.

Silty range site. These are moderately deep and very deep, well drained, medium and moderately fine textured soils. Saturated hydraulic conductivity is moderate and available water capacity is high or very high. This site is on nearly level to steep glacial till plains, lake plains, and high stream terraces. Slope ranges from 1 to 25 percent.

Site retrogression generally results in a decrease in the abundance of such plants as green needlegrass, prairie junegrass, western wheatgrass, and porcupinegrass. The plants that increase in abundance under these conditions are needleandthread, blue grama, threadleaf sedge, needleleaf sedge, and fringed sagewort. Further deterioration results in a dominance of blue grama, threadleaf sedge, needleleaf sedge, fringed sagewort, and other forbs. Kentucky bluegrass often invades as conditions deteriorate.

Generally, no major problems affect management of this site. In the more sloping areas, however, gullies can form in denuded areas.

Subirrigated range site. These are very deep, somewhat poorly and poorly drained, moderately coarse to moderately fine textured soils. These soils have a high water table which keeps the rooting zone moist for most of the growing season. Saturated hydraulic conductivity is moderate to moderately slow and available water capacity is high. This site is on flats and in depressions and drainageways on glacial till plains, lake plains, and outwash plains. Slope ranges from 0 to 3 percent.

Site retrogression results in a decrease in the abundance of such plants as big bluestem, switchgrass, prairie cordgrass, northern reedgrass, indiangrass, and little bluestem. The plants that increase in abundance under these conditions are mat muhly, fowl bluegrass, Baltic rush, common spikerush, and various forbs. Further deterioration results in a dominance of Kentucky bluegrass, other short grasses, grasslike plants, and forbs.

The high percentage of warm-season species on this site can provide high quality forage and wildlife habitat late in the growing season.

Subirrigated Sands range site. These are very deep, somewhat poorly drained, coarse textured soils. Saturated hydraulic conductivity is rapid and available water capacity is low. This site occurs on nearly level or undulating delta plains. Slope ranges from 0 to 6 percent.

Site retrogression results in a decrease in the abundance of such plants as big bluestem, switchgrass, porcupinegrass, and Maximilian sunflower. The plants that increase in abundance under these conditions are sedges, undesirable forbs, and quaking aspen. Kentucky bluegrass is a common invader on this site. When the canopy of quaking aspen approaches 100 percent, the understory is dominated by sedges and shrubs.

The high percentage of warm-season species on this site can provide high-quality forage and wildlife habitat late in the growing season. The combination of grasses, sedges, forbs, shrubs, and trees provides a diversity of wildlife habitat and lends variety and fall color to the landscape. Because of the wide variation in canopy cover, forage production may differ on individual areas of this site. Wind erosion is a concern. It can be controlled by maintaining or reestablishing the climax grasses.

Thin Claypan range site. These are very deep, somewhat poorly to moderately well drained soils. The surface layer is thin, moderately coarse to moderately fine textured, and underlain by a dense sodic subsoil. The subsoils are moderately coarse to fine textured and high in sodium. Saturated hydraulic conductivity is very slow and available water capacity is low to moderate. This site is on nearly level to rolling glacial till plains and lake plains. Slope ranges from 0 to 9 percent.

Site retrogression usually results in a decrease in the abundance of such plants as western wheatgrass, prairie junegrass, and needleandthread. Plants that increase in abundance under these conditions are blue grama, inland saltgrass, Sandberg bluegrass, and alkali muhly. Further deterioration results in a dominance of short grasses, sedges, fringed sagewort, broom snakeweed, and other forbs.

Because of the dense subsoil and high content of subsoil salts, productivity is quite low on this site. Ponds constructed on this site are likely to be salty.

Thin Sands range site. These are very deep, excessively drained, coarse textured soils that have a thin surface horizon. Saturated hydraulic conductivity is rapid and available water capacity is low or very low. These soils are highly susceptible to wind erosion and require careful management. This site is on nearly level to very steep glacial outwash plains and wind-worked delta plains. Slope ranges from 1 to 50 percent.

Site retrogression results in a decrease in the abundance of such plants as prairie sandreed, prairie junegrass, little bluestem, sideoats grama, and sand bluestem. The plants that increase in abundance under these conditions are sand dropseed and upland sedges. Further deterioration results in a dominance of upland sedges, blue grama, and various forbs, and invasion of Kentucky bluegrass.

This site is very fragile. It is subject to wind erosion if the vegetation is damaged by overgrazing or the soil is denuded. Blowouts are common in disturbed areas. Proper management will maintain protective cover and optimum production.

Thin Upland range site. These very deep, well drained, medium and moderately fine textured soils have a thin surface horizon. Saturated hydraulic conductivity is moderately slow and available water capacity is high. This site is on gently sloping to very steep glacial till uplands. Slope ranges from 3 to 50 percent.

Site retrogression results in a decrease in the abundance of such plants as little bluestem, needleandthread, and sideoats grama. The plants that increase in abundance under these conditions are blue grama, red threeawn, upland sedges, and various forbs. Further deterioration results in a dominance of blue grama, upland sedges, and fringed sagewort.

Generally, no major problems affect management of this site. Wind and water erosion are a problem in denuded areas. In the more sloping areas, however, gullies can form along trails.

Very Shallow range site. These are very shallow soils over sand and gravel. They are moderately coarse to medium textured soils underlain by sand and gravel at about 10 inches. They are excessively drained. Saturated hydraulic conductivity is rapid and available water capacity is very low. This site is on nearly level to steep outwash plains and terraces. Slope ranges from 1 to 35 percent.

Site retrogression results in a decrease in the abundance of such plants as needleandthread, western wheatgrass, and plains muhly. The plants that increase in abundance under these conditions are blue grama, red threeawn, sand dropseed, and upland sedges. Further deterioration results in a dominance of blue grama, red threeawn, upland sedges, and various forbs and shrubs.

Available water capacity is very low on this site. Water erosion is a hazard in the more sloping areas. Gullies can form along trails and in denuded areas. Productivity can be maintained by proper management of the dominant mid-grasses.

Wet Meadow range site. These are very deep, poorly drained, medium and fine textured soils that are briefly flooded in the spring and summer. The soils dry at the surface by mid-summer but have water in the root zone. This site occurs in swales and depressions on glacial till plains, glacial lake plains, and outwash channels. The site normally receives additional water from surface runoff and/or underground seepage. Slopes are 0 to 3 percent.

Site retrogression results in a decrease in the abundance of slim sedge, wooly sedge, northern reedgrass, prairie cordgrass, and switchgrass. The plants that increase in abundance under these conditions are fescue sedge, common spikerush, Baltic rush, mat muhly, and fowl bluegrass. Further deterioration results in a dominance of low-growing sedges, short grasses, western dock, and Canada thistle.

This site is easily damaged when it is wet. Grazing during wet periods results in compaction, trampling, and root shearing. The site also is an excellent source of high quality prairie hay.

Wetland range site. These are very deep, very poorly drained soils. Soil texture has little affect as to the kind of vegetation on the site. Water stands over the surface for a major part of the growing season. Saturated hydraulic conductivity of these soils is slow and available water capacity is high. This site is in depressions in glacial till plains, lake basins, and outwash channels. This site normally receives additional amounts of water from surface run-on and/or underground seepage. Slope is commonly less than 1 percent.

Site retrogression results in a decrease in the abundance of such plants as rivergrass, slough sedge, prairie cordgrass, and northern reedgrass. The plants that increase in abundance under these conditions are slim sedge, Baltic rush, common spikesedge, and American sloughgrass. Further deterioration results in a dominance of Baltic rush, common spikesedge, and Mexican dock.

This site is easily damaged when it is wet. Grazing during wet periods results in soil compaction, trampling, and root shearing. Climax vegetation and the important wetland wildlife values are maintained under proper management.

Range Site Plant Community, Composition, and Production

Characteristic vegetation, species composition, total annual production and stocking rates by condition class are shown in Table 12, "Range Site Descriptions."

The **characteristic vegetation** consists of grass, grasslikes, forbs, shrubs, and trees that dominate the natural potential plant community on each range site. The plant species within these groups are listed by **common name**. Under **composition by weight,** the expected percentage of the total annual production is given for each major species and groups of minor species making up the characteristic vegetation.

The range site description helps interpret the ecological and utilitarian values of a given site, including grazing, wildlife habitat, watershed protection, recreation, and others.

Total Annual Production is the amount of vegetation that can be expected to grow annually on well managed rangeland, supporting the potential natural plant community. It includes all vegetation, whether or not palatable to grazing animals. It includes the current year's herbaceous growth, as well as growth of leaves, twigs, and fruit of woody plants. It does not include the increase in stem diameter of trees and shrubs. Potential production depends on the kind of range site. Current production depends on the rangeland condition and the amount of moisture available to the plants during the growing season. Production is expressed in pounds per acre of air-dry herbage for **favorable, average,** and **unfavorable** years, as determined by the amount and distribution of precipitation and the temperatures favorable to growing conditions.

Stocking Rates are based on production and expressed as **animal-unit months** per acre for **excellent, good, fair,** and **poor** range condition classes. Animal-Unit Month (AUM) is the amount of forage required monthly by an animal unit, generally described as one mature cow and calf up to 6 months old.

Range Condition

Range condition indicates the present composition of the plant community on a range site in relation to the climax vegetation. Range condition is determined by comparing the present plant community with the natural potential plant community on a particular range site. The more closely the existing community resembles the potential community, the higher the range condition. Range condition is an ecological rating only, not a forage value rating. Range condition is expressed as **excellent, good, fair**, or **poor**, depending on how closely the present plant community resembles the natural potential plant community. **Excellent** indicates that 76 to 100 percent of the present plant community is the same as the climax vegetation; **good**, 51 to 75 percent; **fair**, 26 to 50 percent; and **poor**, 25 percent or less.

In some cases the plant community found on a site may not look similar to the potential plant community described in Table 12. This is usually due to a lower condition class, reflecting past disturbances, or in some cases long-term exclusion from grazing or fire. Abnormal disturbances that change the natural plant community include prolonged overgrazing or season-long grazing, excessive or untimely burning, erosion, and plowing. Under these circumstances, some of the climax plants decrease in proportion while others increase. Also, plants which were not part of the original native plant community may invade the site. A very severe disturbance, such as plowing, can completely destroy the natural plant community, resulting in dominance of annuals or weedy perennials of a lower plant successional status. If the plant community has not deteriorated significantly, it eventually can return to a higher condition class under proper range management.

Range Management

Range management requires a knowledge of the kinds of soils and of the potential natural plant community. It also requires an evaluation of the present range condition and trend. The primary objective in range management is to manipulate grazing in such a manner that the plants growing on a site are similar in kind and amount to the potential natural plant community for that site. Such management generally results in the optimum

production and diversity of vegetation, suppression of undesirable brush and weeds, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets forage needs, provides wildlife habitat, and protects soil and water resources.

Ecologically sound range management maintains excellent or good range condition. Water is conserved, yields are optimized, and soils are protected. An important management concern is recognizing the changes in the plant community that take place gradually and that can be misinterpreted or overlooked. Growth encouraged by heavy rainfall, for example, may lead to the conclusion that the range is in good condition when actually the plant cover is weedy and the long-term trend is toward lower production. On the other hand, some rangeland that has been grazed closely for a short period may have a degraded appearance that temporarily obscures its quality and ability to recover rapidly.

Rangeland can recover from prolonged overgrazing or other disturbance, if the climax species have not been completely eliminated from the plant community. Generally an adequate population of climax plants remains to restore the rangeland to excellent condition through sound grazing management. In areas where the climax plant community has been severely disturbed or destroyed, range seeding can accelerate improvement in range condition. Seeding the proper climax species also can restore productive rangeland on areas of depleted or low quality cropland or pastureland. Brush suppression, water developments, fencing, and other mechanical practices may be needed to facilitate proper grazing management for range improvement on some rangeland. Proper grazing management is the key to maintaining or improving the productivity and diversity of rangeland.

For additional information about rangeland management, contact the local Natural Resources Conservation Service or Cooperative Extension Service office.

Table 11.-Range Sites

(Dashes (—) indicate an range site is not assigned.
Range sites are for undrained conditions.)

Map symbol and soil name	Range site
110:	
Barnes	Silty
111:	
Barnes	Silty
120:	
Barnes	Silty
Buse	Thin Upland
470:	
Cresbard	Silty
Barnes	Silty
674:	
Farnuf	Silty
676:	
Farnuf	Silty
Sakakawea	Thin Upland
882:	
Hamerly	Limy Subirrigated
Tonka	Wet Meadow
975:	
Heil	Closed Depression
1267:	
Marysland	Wet Meadow
1427:	
Parnell	Wetland
1439:	
Parshall	Sandy
1466:	
Pits, sand and gravel	—
1709:	
Southam	—
1739:	
Straw	Silty
1835:	
Tonka	Wet Meadow
1871:	
Vallers, saline	Saline Lowland

Table 11.-Range Sites--Continued

Map symbol and soil name	Range site
1883:	
Vallers	Wet Meadow
Parnell	Wetland
1978:	
Water	—
2014:	
Williams	Silty
Bowbells	Overflow
2015:	
Williams	Silty
Bowbells	Overflow
2023:	
Williams	Silty
Niobell	Silty
2024:	
Williams	Silty
Niobell	Silty
2031:	
Williams	Silty
Zahl	Thin Upland
2081:	
Zahl	Thin Upland
Williams	Silty
2130:	
Williams	Silty
Zahl	Thin Upland
Parnell	Wetland
2131:	
Zahl	Thin Upland
Williams	Silty
Parnell	Wetland
2169:	
Harriet	Saline Lowland
Stirum	Subirrigated
Regan	Saline Lowland
2170:	
Divide	Limy Subirrigated

Table 11.-Range Sites--Continued

Map symbol and soil name	Range site
2171:	
Sakakawea	Thin Upland
Farnuf	Silty
2172:	
Sakakawea	Thin Upland
Farnuf	Silty
2173:	
Marias	Clayey
2174:	
Marias	Clayey
2175:	
Zahl	Thin Upland
Williams	Silty
2176:	
Zahl	Thin Upland
Williams	Silty
2177:	
Zahl	Thin Upland
Williams	Silty
Vallers	Wet Meadow
2178:	
Farnuf	Silty
Alkabo	Silty
2179:	
Noonan	Claypan
Niobell	Silty
2180:	
Niobell	Silty
Noonan	Claypan
Tonka	Wet Meadow
2181:	
Miranda	Thin Claypan
Noonan	Claypan
2182:	
Portal	Sandy Claypan
Lihen	Sands
2183:	
Lihen	Sands
Blanchard	Thin Sands

Table 11.-Range Sites--Continued

Map symbol and soil name	Range site
2184:	
Williams	Silty
Zahl	Thin Upland
2185:	
Williams	Silty
Zahl	Thin Upland
Lihen	Sands
2186:	
Lehr	Shallow to Gravel
Wabek	Very Shallow
2187:	
Appam	Shallow to Gravel
Wabek	Very Shallow
2188:	
Wabek	Very Shallow
Lehr	Shallow to Gravel
2189:	
Wabek	Very Shallow
Appam	Shallow to Gravel
2190:	
Williams	Silty
2191:	
Towner	Sands
Kratka	Subirrigated
2192:	
Kratka	Subirrigated
Wyndmere	Limy Subirrigated
2193:	
Dumps, mine	—
Ustorthents	Thin Upland
2194:	
Haplustolls	Silty
Ustorthents	Thin Upland
2195:	
Ustorthents	Thin Upland
Haplustolls	Silty
2227:	
Swenoda	Sandy

Table 12.— Range Site Descriptions (MLRA 53A)

Clayey Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Western Wheatgrass		35
	Blue Grama		10
	Green Needlegrass		10
	Needleandthread		5
	Prairie Junegrass		5
	Porcupinegrass	*	
	Prairie Dropseed	*	5
	Slender Wheatgrass	*	
	Bearded Wheatgrass	*	
	Plains Reedgrass	*	5
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Goatsbeard	*	
	Prairie Coneflower	*	10
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2100 to 2300
Average	1800 to 2000
Unfavorable	1500 to 1700

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Claypan Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Western Wheatgrass		40
	Blue Grama		20
	Green Needlegrass		5
	Needleandthread		5
	Prairie Junegrass		5
	Inland Saltgrass	*	
	Porcupinegrass	*	5
	Sandberg Bluegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 5% of Total)	Fringed Sagewort	*	
	Mouseear Chickweed	*	
	Rush Skeletonplant	*	
	Scarlet Globemallow	*	5
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1600 to 1800
Average	1350 to 1550
Unfavorable	1100 to 1300

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Closed Depression Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Western Wheatgrass		50
	Prairie Cordgrass		10
	Nuttall Alkaligrass		10
	Inland Saltgrass		10
	Fowl Bluegrass	*	
	Foxtail Barley	*	
	Slender Wheatgrass	*	Trace
	Other Perennial Grasses	*	
	Common Spikerush	*	
	Needle Spikerush	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Field Mint	*	
	Nuttall Cinquefoil	*	
	Povertyweed	*	10
	Smartweed Species	*	
	Western Dock	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2550 to 2850
Average	2200 to 2500
Unfavorable	1825 to 2150

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.75 to 1.00
Good	0.50 to 0.75
Fair	0.25 to 0.50
Poor	0.10 to 0.25

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Limy Subirrigated Range Site

Characteristic Vegetation	Common Name (Plant Community)		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Little Bluestem		45
	Big Bluestem		15
	Indiangrass	*	10
	Switchgrass	*	
	Green Needlegrass	*	
	Needleandthread	*	
	Slender Wheatgrass	*	10
	Western Wheatgrass	*	
	Other Perennial Grasses	*	
	Rushes	*	10
	Sedge Species	*	
Forbs (0% to 10% of Total)	American Licorice	*	
	Goldenrod Species	*	
	Maximillian Sunflower	*	10
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3400 to 3800
Average	2900 to 3300
Unfavorable	2400 to 2800

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.98 to 1.30
Good	0.65 to 0.98
Fair	0.33 to 0.65
Poor	0.10 to 0.33

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Overflow Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Big Bluestem		25
	Green Needlegrass		15
	Western Wheatgrass		10
	Needleandthread		10
	Porcupinegrass		5
	Other Perennial Grasses		5
	Bearded Wheatgrass	*	
	Little Bluestem	*	5
	Switchgrass	*	
	Canada Wildrye	*	
	Prairie Dropseed	*	5
	Prairie Cordgrass	*	
	Blue Grama	*	
	Indiangrass	*	5
	Mat Muhly	*	
	Fescue Sedge	*	
	Penn Sedge	*	5
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Heath Aster	*	
	Maximillian Sunflower	*	
	Silverleaf Scurfpea	*	10
	Wavyleaf Thistle	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Western Snowberry	*	
	Buffaloberry	*	
	Prairie Rose	*	5
	Common Chokecherry	*	
	Other Perennial Forbs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2900 to 3200
Average	2500 to 2800
Unfavorable	2100 to 2400

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Saline Lowland Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Western Wheatgrass		35
	Inland Saltgrass		15
	Nuttall Alkaligrass		15
	Slender Wheatgrass		10
	Foxtail Barley		5
	Alkali Cordgrass	*	
	Alkali Muhly	*	5
	Plains Bluegrass	*	
	Mat Muhly	*	Trace
	Other Perennial Grasses	*	
	Prairie Bulrush	*	5
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Alkali Plantain	*	
	Pursh Seepweed	*	
	Silverweed Cinquefoil	*	10
	Western Dock	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	2800 to 3150
Average	2425 to 2775
Unfavorable	2050 to 2400

Stocking Rates Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Sands Range Site

Characteristic Vegetation	Common Name (Plant Community)		Composition By Weight (percent)
Grasses and Grasslikes (0% to 80% of Total)	Needleandthread		20
	Prairie Sandreed		20
	Blue Grama		5
	Prairie Junegrass		5
	Sand Bluestem		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Canada Wildrye	*	
	Green Needlegrass	*	5
	Little Bluestem	*	
	Porcupinegrass	*	
	Sand Dropseed	*	
	Panicum	*	Trace
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (0% to 15% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Hairy Goldaster	*	
	Purple Coneflower	*	15
	Purple Prairieclover	*	
	Silky Prairie-Clover	*	
	Stiff Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2400 to 2700
Average	2050 to 2350
Unfavorable	1700 to 2000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.68 to 0.90
Good	0.45 to 0.68
Fair	0.23 to 0.45
Poor	0.10 to 0.23

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Sandy Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Needleandthread		30
	Prairie Sandreed		10
	Western Wheatgrass		10
	Green Needlegrass		5
	Prairie Junegrass		5
	Blue Grama		5
	Other Perennial Grasses		5
	Little Bluestem	*	
	Porcupinegrass	*	5
	Sand Dropseed	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Heath Aster	*	10
	Missouri Goldenrod	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Forbs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2200 to 2500
Average	1875 to 2175
Unfavorable	1550 to 1850

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Sandy Claypan Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
	Plant Community		
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		35
	Needleandthread		20
	Blue Grama		15
	Green Needlegrass		5
	Prairie Junegrass		5
	Inland Saltgrass		5
	Other Perennial Grasses		5
	Sun Sedge	*	5
	Threadleaf Sedge	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Rush Skeletonplant	*	5
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)		*	Trace

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2500 to 3000
Average	1500 to 2000
Unfavorable	500 to 1000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Shallow Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Little Bluestem		25
	Needleandthread		15
	Western Wheatgrass		10
	Blue Grama		5
	Plains Muhly		5
	Prairie Sandreed		5
	Sideoats Grama		5
	Green Needlegrass	*	
	Porcupinegrass	*	Trace
	Prairie Dropseed	*	
	Prairie Junegrass	*	
	Red Threeawn	*	5
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Blacksamson	*	
	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Hairy Goldaster	*	10
	Purple Prairieclover	*	
	Rush Skeletonplant	*	
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Buffaloberry	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1850 to 2000
Average	1600 to 1750
Unfavorable	1350 to 1500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Shallow to Gravel Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Needleandthread		35
	Blue Grama		10
	Green Needlegrass		10
	Western Wheatgrass		10
	Prairie Junegrass		5
	Plains Muhly	*	
	Porcupinegrass	*	5
	Red Threeawn	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Hoods Phlox	*	
	Rush Skeletonplant	*	10
	Scarlet Globemallow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1600 to 1850
Average	1300 to 1550
Unfavorable	1000 to 1250

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Silty Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Needleandthread		20
	Western Wheatgrass		20
	Blue Grama		10
	Green Needlegrass		10
	Porcupinegrass		5
	Prairie Junegrass		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	Trace
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Cudweed Sagewort	*	
	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Heath Aster	*	
	Silverleaf Scurfpea	*	10
	Stiff Sunflower	*	
	Western Ragweed	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2200 to 2400
Average	1900 to 2100
Unfavorable	1600 to 1800

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Subirrigated Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Big Bluestem		35
	Switchgrass		15
	Little Bluestem		10
	Prairie Cordgrass		5
	Mat Muhly		5
	Northern Reedgrass		5
	Indiangrass	*	
	Canada Wildrye	*	5
	Slender Wheatgrass	*	
	Fowl Bluegrass	*	
	Western Wheatgrass	*	5
	Other Perennial Grasses	*	
	Baltic Rush	*	
	Common Spikerush	*	
	Fescue Sedge	*	10
	Slim Sedge	*	
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Field Mint	*	
	Maximillian Sunflower	*	
	Rydberg's Sunflower	*	
	Tall Goldenrod	*	10
	Tall White Aster	*	
	Cinquefoil	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3550 to 3950
Average	3125 to 3525
Unfavorable	2700 to 3100

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.05 to 1.40
Good	0.70 to 1.05
Fair	0.35 to 0.70
Poor	0.10 to 0.35

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Subirrigated Sands Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Switchgrass		20
	Big Bluestem		15
	Porcupinegrass		5
	Prairie Cordgrass		5
	Bluejoint Reedgrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Sedge Species	*	25
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Maximillian Sunflower	*	
	Cudweed Sagewort	*	10
	Western Ragweed	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	
	Willow Species	*	10
	Spirea	*	
	Prairie Rose	*	
	Quaking Aspen		5

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3200 to 3700
Average	2600 to 3100
Unfavorable	2000 to 2500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Thin Claypan Range Site

Plant Community		
Characteristic Vegetation	Common Name	Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Western Wheatgrass	45
	Blue Grama	25
	Inland Saltgrass	5
	Prairie Junegrass	5
	Sandberg Bluegrass	5
	Alkali Muhly *	
	Needleandthread *	
	Nuttall Alkaligrass *	Trace
	Tumble Grass *	
	Other Perennial Grasses *	
	Needleleaf Sedge *	5
	Other Sedges/Rushes *	
Forbs (0% to 5% of Total)	Bladderpod *	
	Fringed Sagewort *	
	Lemon Scurfpea *	
	Rush Skeletonplant *	5
	Scarlet Globemallow *	
	Western Yarrow *	
	Other Perennial Forbs *	
Shrubs and Trees (0% to 5% of Total)	Broom Snakeweed *	5
	Other Perennial Shrubs *	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	750 to 950
Average	525 to 725
Unfavorable	300 to 500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Thin Sands Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 80% of Total)	Needleandthread		25
	Prairie Sandreed		25
	Blue Grama		5
	Prairie Junegrass		5
	Sand Bluestem		5
	Other Perennial Grasses		5
	Canada Wildrye	*	
	Little Blustem	*	Trace
	Sand Dropseed	*	
	Western Wheatgrass	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Hairy Goldaster	*	
	Lemon Scurfpea	*	10
	Missouri Golderod	*	
	Prairie Spiderwort	*	
	Silky Prairie-Clover	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 10% of Total)	Broom Snakeweed	*	
	Leadplant Amorpha	*	10
	Prairie Rose	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1700 to 1950
Average	1400 to 1650
Unfavorable	1100 to 1350

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Thin Upland Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Little Bluestem		20
	Needleandthread		15
	Sideoats Grama		10
	Western Wheatgrass		10
	Blue Grama		5
	Plains Muhly		5
	Prairie Sandreed		5
	Hook Oatgrass	*	
	Porcupinegrass	*	
	Prairie Junegrass	*	
	Green Needlegrass	*	5
	Red Threeawn	*	
	Plains Reedgrass	*	
	Other Perennial Grasses	*	
	Sun Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Dotted Gayfeather	*	
	Black Samsom	*	
	Broom Snakeweed	*	
	Fringed Sagewort	*	
	Missouri Goldenrod	*	10
	Pasqueflower	*	
	Purple Prairieclover	*	
	Stiff Sunflower	*	
	Hoods Phlox	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Silverberry	*	
	Western Snowberry	*	
	Winterfat	*	5
	Other Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2100 to 2300
Average	1800 to 2000
Unfavorable	1500 to 1700

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Very Shallow Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Needleandthread		35
	Blue Grama		10
	Western Wheatgrass		10
	Plains Muhly		5
	Prairie Junegrass		5
	Red Threeawn		5
	Bearded Wheatgrass	*	
	Sand Dropseed	*	5
	Sideoats Grama	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Purple Prairieclover	*	10
	Rush Skeletonplant	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 15% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	800 to 900
Average	600 to 700
Unfavorable	400 to 500

Stocking Rates Condition Class	**AUM Per Acre Per Year
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Wet Meadow Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 90% of Total)	Prairie Cordgrass		10
	Northern Reedgrass		10
	Fescue Sedge		5
	Fowl Bluegrass		5
	Switchgrass		5
	Canada Wildrye	*	
	Mat Muhly	*	5
	Prairie Dropseed	*	
	Other Perennial Grasses	*	
	Slim Sedge	*	45
	Woolly Sedge	*	
	Baltic Rush	*	
	Common Spikerush	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	False Aster	*	
	Field Mint	*	
	Germander	*	
	Macoun's Buttercup	*	10
	Rydberg's Sunflower	*	
	Tall White Aster	*	
	Western Waterhorehound	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	4300 to 4700
Average	3800 to 4200
Unfavorable	3300 to 3700

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.20 to 1.60
Good	0.80 to 1.20
Fair	0.40 to 0.80
Poor	0.10 to 0.40

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53A)--Continued

Wetland Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 95% of Total)	Rivergrass		40
	Prairie Cordgrass		5
	American Mannagrass	*	
	American Sloughgrass	*	
	Reed Canarygrass	*	5
	Northern Reedgrass	*	
	Other Perennial Grasses	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedges/Rushes	*	
	Beaked Sedge	*	
	Slough Sedge	*	35
	Smooth-Cone Sedge	*	
	Water Sedge	*	
	Slim Sedge	*	5
	Woolly Sedge	*	
Forbs (0% to 5% of Total)	Longroot Smartweed	*	
	Mexican Dock	*	
	Waterparsnip	*	5
	Waterplantain	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)	Sandbar Willow	*	Trace
	Willow Species	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	5500 to 5900
Average	5000 to 5400
Unfavorable	4500 to 4900

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	1.58 to 2.10
Good	1.05 to 1.58
Fair	0.53 to 1.05
Poor	0.10 to 0.53

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)

Clayey Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		35
	Blue Grama		10
	Green Needlegrass		10
	Needleandthread		5
	Prairie Junegrass		5
	Porcupinegrass	*	
	Prairie Dropseed	*	5
	Slender Wheatgrass	*	
	Bearded Wheatgrass	*	
	Plains Reedgrass	*	5
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Goatsbeard	*	
	Prairie Coneflower	*	10
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2100 to 2300
Average	1800 to 2000
Unfavorable	1500 to 1700

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Claypan Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		40
	Blue Grama		20
	Green Needlegrass		5
	Needleandthread		5
	Prairie Junegrass		5
	Inland Saltgrass	*	
	Porcupinegrass	*	5
	Sandberg Bluegrass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Mouseear Chickweed	*	
	Rush Skeletonplant	*	5
	Scarlet Globemallow	*	
	Silverleaf Scurfpea	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1600 to 1800
Average	1350 to 1550
Unfavorable	1100 to 1300

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Closed Depression Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		35
	Prairie Cordgrass		15
	Fowl Bluegrass		5
	Foxtail Barley		5
	Inland Saltgrass		5
	Slender Wheatgrass	*	5
	Other Perennial Grasses	*	
	Common Spikerush	*	
	Needle Spikerush	*	15
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Field Mint	*	
	Nuttall Cinquefoil	*	
	Povertyweed	*	15
	Smartweed Species	*	
	Western Dock	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2750 to 3000
Average	2400 to 2650
Unfavorable	2050 to 2300

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.75 to 1.00
Good	0.50 to 0.75
Fair	0.25 to 0.50
Poor	0.10 to 0.25

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Limy Subirrigated Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Little Bluestem		45
	Big Bluestem		15
	Indiangrass	*	10
	Switchgrass	*	
	Green Needlegrass	*	
	Needleandthread	*	10
	Slender Wheatgrass	*	
	Western Wheatgrass	*	
	Other Perennial Grasses	*	
	Rushes	*	10
	Sedge Species	*	
Forbs (5% to 15% of Total)	American Licorice	*	
	Goldenrod Species	*	
	Maximillian Sunflower	*	10
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	3700 to 4100
Average	3200 to 3600
Unfavorable	2700 to 3100

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	1.05 to 1.40
Good	0.70 to 1.05
Fair	0.30 to 0.70
Poor	0.10 to 0.30

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Overflow Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Big Bluestem		25
	Green Needlegrass		10
	Western Wheatgrass		10
	Blue Grama		5
	Little Bluestem		5
	Needleandthread		5
	Porcupinegrass		5
	Other Perennial Grasses		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	5
	Switchgrass	*	
	Canada Wildrye	*	
	Indiangrass	*	5
	Northern Reedgrass	*	
	Prairie Cordgrass	*	
	Fescue Sedge	*	
	Penn Sedge	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Heath Aster	*	
	Maximillian Sunflower	*	
	Silverleaf Scurfpea	*	10
	Wavyleaf Thistle	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	5
	Other Perennial Forbs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	3050 to 3450
Average	2600 to 3000
Unfavorable	2150 to 2550

Stocking Rates

Condition Class	**AUM Per Acre Per Year
Excellent	0.90 to 1.20
Good	0.60 to 0.90
Fair	0.30 to 0.60
Poor	0.10 to 0.30

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Saline Lowland Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		35
	Inland Saltgrass		15
	Nuttall Alkaligrass		15
	Slender Wheatgrass		10
	Foxtail Barley		5
	Alkali Cordgrass	*	
	Alkali Muhly	*	5
	Plains Bluegrass	*	
	Mat Muhly	*	Trace
	Other Perennial Grasses	*	
	Prairie Bulrush	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Alkali Plantain	*	
	Pursh Seepweed	*	
	Silverweed Cinquefoil	*	10
	Western Dock	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2800 to 3150
Average	2425 to 2775
Unfavorable	2050 to 2400

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Sands Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		20
	Prairie Sandreed		20
	Blue Grama		5
	Prairie Junegrass		5
	Sand Bluestem		5
	Western Wheatgrass		5
	Bearded Wheatgrass	*	
	Canada Wildrye	*	
	Green Needlegrass	*	5
	Little Bluestem	*	
	Porcupinegrass	*	
	Sand Dropseed	*	
	Panicum	*	Trace
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Hairy Goldaster	*	
	Purple Coneflower	*	15
	Purple Prairieclover	*	
	Silky Prairie-Clover	*	
	Stiff Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2400 to 2700
Average	2050 to 2350
Unfavorable	1700 to 2000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.68 to 0.90
Good	0.45 to 0.68
Fair	0.23 to 0.45
Poor	0.10 to 0.23

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Sandy Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		25
	Prairie Sandreed		20
	Blue Grama		5
	Green Needlegrass		5
	Prairie Junegrass		5
	Western Wheatgrass		5
	Other Perennial Grasses		5
	Little Bluestem	*	
	Panicum	*	
	Porcupinegrass	*	Trace
	Sand Dropseed	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Heath Aster	*	10
	Missouri Goldenrod	*	
	Western Ragweed	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Leadplant Amorpha	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Forbs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	2500 to 2700
Average	2200 to 2400
Unfavorable	1900 to 2100

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	0.68 to 0.90
Good	0.45 to 0.68
Fair	0.23 to 0.45
Poor	0.10 to 0.23

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Sandy Claypan Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		35
	Needleandthread		20
	Blue Grama		15
	Green Needlegrass		5
	Prairie Junegrass		5
	Inland Saltgrass		5
	Other Perennial Grasses		5
	Sun sedge	*	5
	Threadleaf sedge	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Rush skeletonplant	*	5
	Scarlet Globemallow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)		*	Trace

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2500 to 3000
Average	1500 to 2000
Unfavorable	500 to 1000

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Shallow Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Little Bluestem		25
	Needleandthread		15
	Western Wheatgrass		10
	Blue Grama		5
	Plains Muhly		5
	Prairie Sandreed		5
	Sideoats Grama		5
	Green Needlegrass	*	
	Porcupinegrass	*	Trace
	Prairie Dropseed	*	
	Prairie Junegrass	*	
	Red Threeawn	*	5
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Blacksamson	*	
	Cudweed Sagewort	*	
	Fringed Sagewort	*	
	Hairy Goldaster	*	10
	Purple Prairieclover	*	
	Rush Skeletonplant	*	
	Stiff Sunflower	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Buffaloberry	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1850 to 2000
Average	1600 to 1750
Unfavorable	1350 to 1500

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Shallow to Gravel Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		35
	Blue Grama		10
	Green Needlegrass		10
	Western Wheatgrass		10
	Prairie Junegrass		5
	Plains Muhly	*	
	Porcupinegrass	*	5
	Red Threeawn	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Hoods Phlox	*	
	Rush Skeletonplant	*	10
	Scarlet Globemallow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1600 to 1850
Average	1300 to 1550
Unfavorable	1000 to 1250

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Silty Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		20
	Western Wheatgrass		20
	Blue Grama		10
	Green Needlegrass		10
	Porcupinegrass		5
	Prairie Junegrass		5
	Bearded Wheatgrass	*	
	Prairie Dropseed	*	Trace
	Other Perennial Grasses	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	15
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Cudweed Sagewort	*	
	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Heath Aster	*	10
	Silverleaf Scurfpea	*	
	Stiff Sunflower	*	
	Western Ragweed	*	
	Western Yarrow	*	
	Woolly Goldenrod	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Prairie Rose	*	
	Western Snowberry	*	5
	Other Perennial Shrubs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	2200 to 2400
Average	1900 to 2100
Unfavorable	1600 to 1800

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	0.60 to 0.80
Good	0.40 to 0.60
Fair	0.20 to 0.40
Poor	0.10 to 0.20

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Subirrigated Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Big Bluestem		40
	Switchgrass		15
	Little Bluestem		5
	Prairie Cordgrass		5
	Indiangrass	*	
	Northern Reedgrass	*	5
	Slender Wheatgrass	*	
	Mat Muhly	*	
	Tall Dropseed	*	5
	Western Wheatgrass	*	
	Fowl Bluegrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Baltic Rush	*	
	Common Spikerush	*	
	Fescue Sedge	*	10
	Slim Sedge	*	
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Field Mint	*	
	Maximillian Sunflower	*	
	Rydberg's Sunflower	*	10
	Tall Goldenrod	*	
	Tall White Aster	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% of Total)			

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	3850 to 4250
Average	3425 to 3825
Unfavorable	3000 to 3400

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.13 to 1.50
Good	0.75 to 1.13
Fair	0.38 to 0.75
Poor	0.10 to 0.38

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Subirrigated Sands Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Switchgrass		20
	Big Bluestem		15
	Porcupinegrass		5
	Prairie Cordgrass		5
	Bluejoint Reedgrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Sedge Species	*	25
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Maximillian Sunflower	*	
	Cudweed Sagewort	*	10
	Western Ragweed	*	
Shrubs and Trees (5% to 15% of Total)	Western Snowberry	*	
	Willow Species	*	10
	Spirea	*	
	Prairie Rose	*	
	Quaking Aspen		5

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	3200 to 3700
Average	2600 to 3100
Unfavorable	2000 to 2500

Stocking Rates

Condition Class	**AUM Per Acre Per Year
Excellent	0.83 to 1.10
Good	0.55 to 0.83
Fair	0.28 to 0.55
Poor	0.10 to 0.28

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Thin Claypan Range Site

Characteristic Vegetation	Common Name (Plant Community)		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Western Wheatgrass		45
	Blue Grama		25
	Inland Saltgrass		5
	Prairie Junegrass		5
	Sandberg Bluegrass		5
	Alkali Muhly	*	
	Needleandthread	*	
	Nuttall Alkaligrass	*	Trace
	Tumble Grass	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Bladderpod	*	
	Fringed Sagewort	*	
	Lemon Scurfpea	*	5
	Rush Skeletonplant	*	
	Scarlet Globemallow	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	5
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	850 to 1100
Average	575 to 825
Unfavorable	300 to 550

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Thin Sands Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		25
	Prairie Sandreed		25
	Blue Grama		5
	Prairie Junegrass		5
	Sand Bluestem		5
	Other Perennial Grasses		5
	Canada Wildrye	*	
	Little Blustem	*	Trace
	Sand Dropseed	*	
	Western Wheatgrass	*	
	Penn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Fringed Sagewort	*	
	Green Sagewort	*	
	Hairy Goldaster	*	
	Lemon Scurfpea	*	10
	Missouri Golderod	*	
	Prairie Spiderwort	*	
	Silky Prairie-Clover	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	
	Leadplant Amorpha	*	10
	Prairie Rose	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	1700 to 1950
Average	1400 to 1650
Unfavorable	1100 to 1350

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.45 to 0.60
Good	0.30 to 0.45
Fair	0.15 to 0.30
Poor	0.10 to 0.15

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Thin Upland Range Site

Plant Community			
Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (0% to 85% of Total)	Little Bluestem		20
	Needleandthread		15
	Western Wheatgrass		10
	Sideoats Grama		10
	Blue Grama		5
	Plains Muhly		5
	Prairie Sandreed		5
	Green Needlegrass	*	
	Hooker Oatgrass	*	Trace
	Prairie Junegrass	*	
	Porcupinegrass	*	
	Red Threeawn	*	5
	Other Perennial Grasses	*	
	Sunn Sedge	*	
	Threadleaf Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (0% to 10% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Missouri Golderod	*	
	Pasqueflower	*	10
	Hoods Phlox	*	
	Black Samson	*	
	Purple Prairieclover	*	
	Stiff Sunflower	*	
	Broom Snakeweed	*	
	Other Perennial Forbs	*	
Shrubs and Trees (0% to 5% of Total)	Western Snowberry		
	Prairie Rose	*	5
	Silverberry	*	
	Other Perennial Shrubs	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	2100 to 2300
Average	1800 to 2000
Unfavorable	1500 to 1700

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	0.53 to 0.70
Good	0.35 to 0.53
Fair	0.18 to 0.35
Poor	0.10 to 0.18

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Very Shallow Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Needleandthread		35
	Blue Grama		10
	Western Wheatgrass		10
	Plains Muhly		5
	Prairie Junegrass		5
	Red Threeawn		5
	Bearded Wheatgrass	*	
	Sand Dropseed	*	5
	Sideoats Grama	*	
	Other Perennial Grasses	*	
	Needleleaf Sedge	*	
	Penn Sedge	*	10
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	Dotted Gayfeather	*	
	Fringed Sagewort	*	
	Green Sagewort	*	
	Purple Prairieclover	*	10
	Rush Skeletonplant	*	
	Western Yarrow	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Broom Snakeweed	*	
	Prairie Rose	*	5
	Western Snowberry	*	
	Other Perennial Shrubs	*	

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	900 to 1100
Average	675 to 875
Unfavorable	450 to 650

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	0.23 to 0.30
Good	0.15 to 0.23
Fair	0.08 to 0.15
Poor	0.05 to 0.08

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Wet Meadow Range Site

Characteristic Vegetation	Plant Community: Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Prairie Cordgrass		10
	Fescue Sedge		5
	Northern Reedgrass		5
	Switchgrass		5
	Fowl Bluegrass	*	
	Mat Muhly	*	5
	Other Perennial Grasses	*	
	Slim Sedge	*	55
	Woolly Sedge	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedges/Rushes	*	
Forbs (5% to 15% of Total)	False Aster	*	
	Field Mint	*	
	Germander	*	10
	Macoun's Buttercup	*	
	Rydberg's Sunflower	*	
	Tall White Aster	*	
	Western Waterhorehound	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)			

Total Annual Production Climatic Condition	(Excellent Condition) Pounds Per Acre (dry)
Favorable	4500 to 4900
Average	4000 to 4200
Unfavorable	3500 to 3900

Stocking Rates: Condition Class	**AUM Per Acre Per Year
Excellent	1.28 to 1.70
Good	0.85 to 1.28
Fair	0.43 to 0.85
Poor	0.10 to 0.85

*Indicates the composition for species group
**Animal units per month

Table 12.— Range Site Descriptions (MLRA 53B)--Continued

Wetland Range Site

Characteristic Vegetation	Common Name		Composition By Weight (percent)
Grasses and Grasslikes (70% to 90% of Total)	Rivergrass		35
	Northern Reedgrass		5
	Prairie Cordgrass		5
	American Mannagrass	*	
	American Sloughgrass	*	
	Reed Canarygrass	*	5
	Other Perennial Grasses	*	
	Baltic Rush	*	
	Common Spikerush	*	5
	Other Sedged/Rushes	*	
	Beaked Sedge	*	
	Slough Sedge	*	35
	Smooth-Cone Sedge	*	
	Water Sedge	*	
	Slim Sedge	*	5
	Woolly Sedge	*	
Forbs (5% to 15% of Total)	Longroot Smartweed	*	
	Mexican Dock	*	
	Nuttall Cinquefoil	*	5
	Waterparsnip	*	
	Waterplantain	*	
	Other Perennial Forbs	*	
Shrubs and Trees (5% to 15% of Total)	Sandbar Willow	*	Trace
	Willow Species	*	

Total Annual Production	(Excellent Condition)
Climatic Condition	Pounds Per Acre (dry)
Favorable	5700 to 6100
Average	5200 to 5600
Unfavorable	4700 to 5100

Stocking Rates	
Condition Class	**AUM Per Acre Per Year
Excellent	1.65 to 2.20
Good	1.10 to 1.65
Fair	0.55 to 1.10
Poor	0.10 to 0.55

*Indicates the composition for species group
**Animal units per month

Recreation

Public areas in Burke County provide opportunities for numerous recreational activities, including: fishing, hiking, bird-watching, and hunting. For information on recreational activities in Burke County contact the North Dakota State Department of Parks and Recreation.

Soils in the survey area are rated in Table 13, "Recreational Development," according to limitations affecting their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area, and its scenic quality, ability of the soil to support vegetation, access to water, potential water impoundment sites, and either access to public sewer lines or the capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreational uses by the duration of flooding and the season when it occurs. Onsite assessment of the height, duration, intensity, and frequency of flooding is essential in planning recreational facilities.

Camp areas are tracts of land used intensively as sites for tents, trailers, and campers and for outdoor activities that accompany such sites. These areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. Soils are rated on the basis of soil properties that influence ease of developing camp areas and performance of the areas after development. Also considered are soil properties that influence trafficability and promote the growth of vegetation after heavy use.

Picnic areas are natural or landscaped tracts of land subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. Soils are rated on the basis of soil properties influencing cost of shaping the site, trafficability, and growth of vegetation after development. The surface of picnic areas should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Playgrounds are areas used intensively for baseball, football, or similar activities. These areas require a nearly level soil that is free of stones and can withstand heavy foot traffic and maintain an adequate cover of vegetation. Soils are rated on the basis of soil properties influencing the cost of shaping the site, trafficability, and the growth of vegetation. Slope and stoniness are the main concerns in developing playgrounds. The surface of the playgrounds should absorb rainfall readily, remain firm under heavy foot traffic, and not be dusty when dry.

Paths and trails are areas used for hiking and horseback riding. The areas should require little or no cutting and filling during site preparation. Soils are rated on the basis of soil properties influencing trafficability and erodibility. Paths and trails should remain firm under foot traffic and not be dusty when dry.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Interpretative ratings in Table 13 help engineers, planners, and others understand how soil properties influence recreational uses. Ratings for proposed uses are given in terms of limitations. Only the most restrictive features are listed. Other features may limit a specific recreational use.

The degree of soil limitation is expressed as **slight, moderate,** or **severe**.

Slight means soil properties are generally favorable for the rated use. Limitations are minor and can be easily overcome. Good performance and low maintenance are expected.

Moderate means soil properties are moderately favorable for the rated use. Limitations can be overcome or modified by special planning, design, or maintenance. During some part of the year, the expected performance may be less desirable than soils rated slight.

Severe means soil properties are unfavorable for the rated use. Examples of limitations are slope, bedrock near the surface, flooding, and a seasonal high water table. These limitations generally require major soil reclamation, special design, or intensive maintenance. Overcoming the limitations generally is difficult and costly.

Information in Table 13, "Recreational Development," can be supplemented by other information in this survey. For example, interpretations for dwellings without basements and for local roads and streets in Table 15, "Building Site Development," and interpretations for septic tank absorption fields in Table 16, "Sanitary Facilities," can supplement information obtained from Table 13.

Table 13.-Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes (—) indicate that the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
110:					
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
111:					
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
120:					
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
Buse	Slight	Slight	Severe: slope	Slight	Slight
470:					
Cresbard	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Barnes	Slight	Slight	Moderate: slope small stones	Slight	Slight
674:					
Farnuf	Slight	Slight	Slight	Slight	Slight
676:					
Farnuf	Slight	Slight	Slight	Slight	Slight
Sakakawea	Slight	Slight	Moderate: slope	Slight	Slight
882:					
Hamerly	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: percs slowly wetness	Moderate: wetness	Moderate: wetness
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
975:					
Heil	Severe: percs slowly ponding	Severe: excess sodium ponding	Severe: percs slowly ponding	Severe: ponding	Severe: excess sodium ponding
1267:					
Marysland	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
1427:					
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding

Table 13.-Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
1439:					
Parshall	Slight	Slight	Moderate: slope	Slight	Slight
1466:					
Pits, sand and gravel	Severe: slope small stones	Severe: slope too sandy	Severe: slope small stones	Severe: slope too sandy	Severe: slope small stones droughty
1709:					
Southam	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1739:					
Straw	Severe: flooding	Slight	Moderate: slope	Slight	Moderate: flooding
1835:					
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1871:					
Vallers, saline	Severe: wetness	Moderate: percs slowly wetness	Severe: wetness	Moderate: wetness	Moderate: wetness
1883:					
Vallers	Severe: wetness	Moderate: percs slowly wetness	Severe: wetness	Moderate: wetness	Moderate: wetness
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
1978:					
Water	—	—	—	—	—
2014:					
Williams	Slight	Slight	Slight	Slight	Slight
Bowbells	Slight	Slight	Slight	Slight	Slight
2015:					
Williams	Slight	Slight	Severe: slope	Slight	Slight
Bowbells	Slight	Slight	Slight	Slight	Slight
2023:					
Williams	Slight	Slight	Slight	Slight	Slight
Niobell	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
2024:					
Williams	Slight	Slight	Severe: slope	Slight	Slight
Niobell	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium

Table 13.-Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2031:					
Williams	Slight	Slight	Severe: slope	Slight	Slight
Zahl	Slight	Slight	Moderate: slope	Slight	Slight
2081:					
Zahl	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Williams	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
2130:					
Williams	Slight	Slight	Severe: slope	Slight	Slight
Zahl	Slight	Slight	Moderate: slope	Slight	Slight
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
2131:					
Zahl	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope
Williams	Slight	Slight	Severe: slope	Slight	Slight
Parnell	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding
2169:					
Harriet	Severe: flooding percs slowly wetness	Severe: excess sodium percs slowly wetness	Severe: percs slowly wetness	Severe: wetness	Severe: excess sodium wetness
Regan	Severe: excess salt flooding wetness	Severe: excess salt wetness	Severe: excess salt wetness	Severe: wetness	Severe: excess salt wetness
Stirum	Severe: excess sodium flooding wetness	Severe: excess sodium	Severe: excess sodium wetness	Moderate: wetness	Severe: excess sodium
2170:					
Divide	Slight	Slight	Slight	Slight	Slight
2171:					
Sakakawea	Slight	Slight	Severe: slope	Slight	Slight
Farnuf	Slight	Slight	Severe: slope	Slight	Slight
2172:					
Sakakawea	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope

Table 13.-Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2172:(cont.)					
Farnuf	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
2173:					
Marias	Moderate: percs slowly too clayey	Moderate: percs slowly too clayey	Moderate: percs slowly too clayey	Severe: erodes easily	Severe: too clayey
2174:					
Marias	Moderate: percs slowly too clayey	Moderate: percs slowly too clayey	Moderate: percs slowly too clayey	Severe: erodes easily	Severe: too clayey
2175:					
Zahl	Slight	Slight	Moderate: slope	Slight	Slight
Williams	Slight	Slight	Severe: slope	Slight	Slight
2176:					
Zahl	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Williams	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
2177:					
Zahl	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Williams	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Vallers	Severe: wetness	Moderate: percs slowly wetness	Severe: wetness	Moderate: wetness	Moderate: wetness
2178:					
Farnuf	Slight	Slight	Slight	Slight	Slight
Alkabo	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
2179:					
Noonan	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Niobell	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
2180:					
Niobell	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Noonan	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Tonka	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding	Severe: ponding

Table 13.-Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2181:					
Miranda	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Noonan	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
2182:					
Portal	Severe: excess sodium	Severe: excess sodium	Severe: excess sodium	Slight	Severe: excess sodium
Lihen	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
2183:					
Lihen	Moderate: too sandy	Moderate: too sandy	Moderate: slope too sandy	Moderate: too sandy	Moderate: droughty
Blanchard	Slight	Slight	Moderate: slope	Slight	Moderate: droughty
2184:					
Williams	Slight	Slight	Moderate: slope	Slight	Slight
Zahl	Slight	Slight	Moderate: slope	Slight	Slight
2185:					
Williams	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Zahl	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope
Lihen	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope droughty
2186:					
Lehr	Slight	Slight	Moderate: slope	Slight	Moderate: droughty
Wabek	Slight	Slight	Moderate: slope	Slight	Severe
2187:					
Appam	Slight	Slight	Moderate: slope small stones	Slight	Moderate: droughty
Wabek	Slight	Slight	Moderate: slope	Slight	Severe
2188:					
Wabek	Slight	Slight	Moderate: slope	Slight	Severe
Lehr	Slight	Slight	Moderate: slope	Slight	Moderate: droughty

Table 13.-Recreational Development--Continued

Map symbol and soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
2189:					
Wabek	Slight	Slight	Moderate: slope	Slight	Severe
Appam	Slight	Slight	Moderate: slope small stones	Slight	Moderate: droughty
2190:					
Williams	Slight	Slight	Moderate: slope	Slight	Slight
2191:					
Towner	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: too sandy	Moderate: droughty
Kratka	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
2192:					
Kratka	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Wyndmere	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness	Moderate: wetness droughty
2193:					
Dumps, mine	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Ustorthents	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
2194:					
Haplustolls	Slight	Slight	Moderate: slope	Slight	Slight
Ustorthents	Slight	Slight	Moderate: slope	Slight	Slight
2195:					
Ustorthents	Slight	Slight	Severe: slope	Slight	Slight
Haplustolls	Slight	Slight	Severe: slope	Slight	Slight
2227:					
Swenoda	Slight	Slight	Slight	Slight	Slight

Wildlife Habitat

Soils affect the kind and amount of vegetation that is available to wildlife for food and cover. They also affect the construction of water impoundments. If food, cover, or water is missing, inadequate, or inaccessible, wildlife will be scarce or will not inhabit the area.

If the soils have potential for habitat development, wildlife habitat can be created or improved by planting appropriate vegetation, properly managing existing plant cover, and fostering the natural establishment of desirable plants.

On Table 14, "Wildlife Habitat," soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife. It can also be used for selecting soils suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil for wildlife habitat is rated **good, fair, poor,** or **very poor**. A rating of **good** indicates the kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of **fair** indicates the kind of wildlife habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of **poor** indicates limitations are severe for the designated kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of **very poor** indicates restrictions for the element or kind of wildlife habitat are very severe and unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat shown on Table 14 are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants used by wildlife. Examples are wheat, rye, oats, corn, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes planted for wildlife food and cover. Examples are bromegrass, intermediate wheatgrass, tall wheatgrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Examples are bluestem, goldenrod, blue grama, switchgrass, Maximilian sunflower, and western wheatgrass.

The major soil properties affecting the growth of grain and forage crops and wild herbaceous plants are depth of the root zone, texture of the surface layer, the amount of water available to plants, wetness, salinity or sodicity, and flooding. The length of the growing season also is important.

Hardwood trees produce nuts or other fruit, buds, catkins, twigs, bark, and foliage that wildlife eat. Examples are oak, poplar, boxelder, green ash, willow, and American elm.

Coniferous plants are cone-bearing trees, shrubs, or ground cover that provide habitat or supply food in the form of browse, seed, or fruitlike cones. Examples are pine, spruce, cedar, and juniper.

The major soil properties affecting the growth of hardwood and coniferous trees and shrubs are depth of root zone, the amount of water available to plants, and wetness.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the rooting zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, buffaloberry, snowberry, juneberry, hawthorn, American plum, and redosier dogwood.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Wetland plants produce food or cover for wetland wildlife. Examples of these plants are smartweed, sedges, bulrushes, white top, common reedgrass, saltgrass, prairie cordgrass, and cattail.

The major soil properties affecting wetland plants are texture of the surface layer, wetness, acidity or alkalinity, and slope.

Shallow water areas have an average depth of less than 5 feet. They are useful as habitat for some wildlife species. They are naturally wet areas or are created by dams, levees, or water-control measures in marshes or streams. Examples are muskrat marshes, waterfowl feeding areas, wildlife watering developments, beaver ponds, and other wildlife ponds.

The major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and saturated hydraulic conductivity.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, and shrubs. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, pheasant, sharptail grouse, meadowlark, lark bunting, cottontail rabbit, and red fox.

Habitat for woodland wildlife consists of areas of hardwoods or conifers or a mixture of these and associated grasses, legumes, and wild herbaceous plants. The wildlife attracted to this habitat include thrushes, woodpeckers, owls, tree squirrels, porcupine, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy, shallow water areas that support water-tolerant plants. The wildlife attracted to this habitat include ducks, geese, herons, shore birds, muskrat, mink, and beaver. (fig. 16)

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. The wildlife attracted to rangeland include deer, sharptail grouse, western meadowlark, and David's sparrow.

Figure 16. Geese feeding on an area of Noonan-Niobell loams, 1 to 6 percent slopes.

Table 14.-Wildlife Habitat

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Dashes (—) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for—: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
110:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
111:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
120:												
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Buse	Fair	Good	Fair	—	—	Fair	Very poor	Very poor	Fair	—	Very poor	Fair
470:												
Cresbard	Fair	Fair	Good	Fair	Very poor	Poor	Very poor	Very poor	Fair	Very poor	Very poor	Good
Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
674:												
Farnuf	Good	Good	Good	Good	Very poor	Fair	Very poor	Very poor	Good	—	Very poor	Fair
676:												
Farnuf	Good	Good	Good	Good	Very poor	Fair	Very poor	Very poor	Good	—	Very poor	Fair
Sakakawea	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
882:												
Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Fair	Good	Good	Fair	Fair
Tonka	Poor	Poor	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
975:												
Heil	Poor	Poor	Fair	Poor	Poor	Very poor	Good	Good	Poor	Poor	Good	Poor
1267:												
Marysland	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair
1427:												
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
1439:												
Parshall	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
1466:												
Pits, sand and gravel	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor

Table 14.-Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
1709:												
Southam	Very poor	Very poor	Very poor	—	—	Very poor	Good	Good	Very poor	—	Good	Very poor
1739:												
Straw	Good	Good	Good	—	—	Good	Poor	Poor	Good	—	Poor	Good
1835:												
Tonka	Poor	Poor	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
1871:												
Vallers, saline	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair
1883:												
Vallers	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
1978:												
Water	—	—	—	—	—	—	—	—	—	—	—	—
2014:												
Williams	Fair	Good	Good	Fair	Good	Fair	Poor	Very poor	Good	Fair	Very poor	Fair
Bowbells	Good	Good	Good	—	—	Good	Poor	Poor	Good	—	Poor	Good
2015:												
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Bowbells	Good	Good	Good	—	—	Good	Poor	Poor	Good	—	Poor	Good
2023:												
Williams	Fair	Good	Good	Fair	Good	Fair	Poor	Very poor	Good	Fair	Very poor	Fair
Niobell	Fair	Fair	Good	Fair	Fair	Poor	Poor	Very poor	Fair	Fair	Very poor	Fair
2024:												
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Niobell	Fair	Fair	Good	Fair	Fair	Poor	Poor	Very poor	Fair	Fair	Very poor	Fair
2031:												
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Zahl	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
2081:												
Zahl	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor	Good	Fair	Very poor	Fair

Table 14.-Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for—: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2081:(cont.)												
Williams	Fair	Good	Good	Fair	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2130:												
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Zahl	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
2131:												
Zahl	Very poor	Poor	Good	Fair	Fair	Fair	Very poor	Very poor	Poor	Fair	Very poor	Fair
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Parnell	Very poor	Poor	Poor	Very poor	Very poor	Poor	Good	Good	Poor	Very poor	Good	Poor
2169:												
Harriet	Poor	Poor	Fair	Poor	Poor	Very poor	Good	Good	Poor	Poor	Good	Poor
Regan	Fair	Fair	Fair	—	—	Very poor	Good	Good	Fair	—	Good	Poor
Stirum	Very poor	Very poor	Very poor	Poor	Poor	Fair	Good	Fair	Very poor	Poor	Fair	Poor
2170:												
Divide	Fair	Fair	Good	Good	Good	Fair	Fair	Very poor	Fair	Good	Poor	Fair
2171:												
Sakakawea	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
Farnuf	Fair	Good	Fair	Good	Very poor	Fair	Very poor	Very poor	Fair	—	Very poor	Fair
2172:												
Sakakawea	Very poor	Very poor	Good	—	—	Fair	Very poor	Very poor	Poor	—	Very poor	Fair
Farnuf	Poor	Good	Fair	Good	Very poor	Fair	Very poor	Very poor	Poor	—	Very poor	Fair
2173:												
Marias	Good	Good	Fair	—	—	Poor	Poor	Very poor	Good	—	Poor	Poor
2174:												
Marias	Good	Good	Fair	—	—	Poor	Poor	Very poor	Good	—	Poor	Poor

Table 14.-Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for—: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2175:												
Zahl	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
Williams	Fair	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2176:												
Zahl	Very poor	Very poor	Good	—	—	Fair	Very poor	Very poor	Poor	—	Very poor	Fair
Williams	Very poor	Very poor	Good	Good	Good	Fair	Very poor	Very poor	Poor	Good	Very poor	Fair
2177:												
Zahl	Very poor	Very poor	Good	—	—	Fair	Very poor	Very poor	Poor	—	Very poor	Fair
Williams	Very poor	Very poor	Good	Good	Good	Fair	Very poor	Very poor	Poor	Good	Very poor	Fair
Vallers	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair
2178:												
Farnuf	Good	Good	Good	Good	Very poor	Fair	Very poor	Very poor	Good	—	Very poor	Fair
Alkabo	Fair	Fair	Good	Fair	Fair	Poor	Poor	Poor	Fair	Fair	Poor	Fair
2179:												
Noonan	Poor	Poor	Very poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Poor	Very poor	Very poor
Niobell	Fair	Fair	Good	Fair	Fair	Poor	Poor	Very poor	Fair	Fair	Very poor	Fair
2180:												
Niobell	Fair	Fair	Good	Fair	Fair	Poor	Poor	Very poor	Fair	Fair	Very poor	Fair
Noonan	Poor	Poor	Very poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Poor	Very poor	Very poor
Tonka	Poor	Poor	Fair	Fair	Fair	Poor	Good	Good	Poor	Fair	Good	Poor
2181:												
Miranda	Poor	Poor	Very poor	Poor	Very poor	Very poor	Poor	Poor	Poor	Poor	Poor	Very poor
Noonan	Poor	Poor	Very poor	Poor	Poor	Very poor	Poor	Very poor	Poor	Poor	Very poor	Very poor
2182:												
Portal	Fair	Good	Poor	—	—	Fair	Poor	Very poor	Fair	—	Very poor	Poor
Lihen	Fair	Good	Fair	—	—	Fair	Very poor	Very poor	Fair	—	Very poor	Fair

Table 14.-Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for—: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2183:												
Lihen	Fair	Good	Fair	—	—	Fair	Very poor	Very poor	Fair	—	Very poor	Fair
Blanchard	Poor	Fair	Fair	—	—	Good	Very poor	Very poor	Fair	—	Very poor	Fair
2184:												
Williams	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Zahl	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
2185:												
Williams	Fair	Good	Good	Fair	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
Zahl	Fair	Good	Good	Fair	Fair	Fair	Poor	Very poor	Good	Fair	Very poor	Fair
Lihen	Poor	Fair	Fair	—	—	Fair	Very poor	Very poor	Fair	—	Very poor	Fair
2186:												
Lehr	Fair	Good	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Fair	Very poor	Fair
Wabek	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor
2187:												
Appam	Fair	Good	Fair	—	—	Poor	Very poor	Very poor	Fair	—	Very poor	Poor
Wabek	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor
2188:												
Wabek	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor
Lehr	Fair	Good	Fair	Fair	Fair	Poor	Very poor	Very poor	Fair	Fair	Very poor	Fair
2189:												
Wabek	Very poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor
Appam	Fair	Good	Fair	—	—	Poor	Very poor	Very poor	Fair	—	Very poor	Poor
2190:												
Williams	Good	Good	Good	Good	Good	Fair	Poor	Very poor	Good	Good	Very poor	Fair
2191:												
Towner	Fair	Good	Good	Good	Good	Fair	Poor	Poor	Good	Good	Poor	Fair
Kratka	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair

Table 14.-Wildlife Habitat--Continued

Map symbol and soil name	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for—: Openland wildlife	Woodland wildlife	Wetland wildlife	Rangeland wildlife
2192:												
Kratka------------------	Poor	Fair	Fair	—	—	Fair	Good	Good	Fair	—	Good	Fair
Wyndmere----------------	Fair	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor	Fair
2193:												
Dumps, mine-------------	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
Ustorthents-------------	Very poor	Very poor	Good	—	—	Fair	Very poor	Very poor	Poor	—	Very poor	Fair
2194:												
Haplustolls-------------	Good	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
Ustorthents-------------	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
2195:												
Ustorthents-------------	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
Haplustolls-------------	Fair	Good	Good	—	—	Fair	Poor	Very poor	Good	—	Very poor	Fair
2227:												
Swenoda-----------------	Fair	Good	Good	—	—	Fair	Very poor	Very poor	Good	—	Very poor	Fair

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 15, "Building Site Development" shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered **slight** if soil properties and site features generally are favorable for the indicated use and limitations are minor and easily overcome; **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth

to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills generally are limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, potential for frost action, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 16, "Sanitary Facilities" shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. It also shows the suitability of the soils for use as a daily cover for landfill.

Soil properties are important in selecting sites for sanitary facilities and in identifying limiting soil properties and site features to be considered in planning, design, and installation. Soil limitation ratings of **slight**, **moderate**, or **severe** are given for septic tank absorption fields, sewage lagoons, and trench and area sanitary landfills. Soil suitability ratings of **good**, **fair**, and **poor** are given for daily cover for landfill.

A rating of **slight** or **good** indicates that the soils have no limitations or that the limitations can be easily overcome. Good performance and low maintenance can be expected. A rating of **moderate** or **fair** indicates that the limitations should be recognized but generally can be overcome by good management or special design. A rating of **severe** or **poor** indicates that overcoming the limitations is difficult or impractical. Increased maintenance may be required.

Septic tank absorption fields are areas in which subsurface systems of tile or perforated pipe distribute effluent from a septic tank into the natural soil. The centerline of the tile is assumed to be at a depth of 24 inches. Only the part of the soil between depths of 24 and 60 inches is considered in making the ratings. The soil properties and site features considered are those that affect the absorption of the effluent, those that affect the construction and maintenance of the system, and those that may affect public health.

The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted, relatively impervious soil material. Aerobic lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Relatively

impervious soil material for the lagoon floor and sides is desirable to minimize seepage and contamination of local ground water.

Table 16, "Sanitary Facilities" gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Trench sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers in an excavated trench. The waste is spread, compacted, and covered daily with a thin layer of soil that is excavated from the trench. When the trench is full, a final cover of soil material at least 2 feet thick is placed over the landfill. Soil properties that influence the risk of pollution, the ease of excavation, trafficability, and revegetation are the major considerations in rating the soils.

Area sanitary landfill is an area where solid waste is disposed of by placing refuse in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil that is imported from a source away from the site. A final cover of soil at least 2 feet thick is placed over the completed landfill. Soil properties that influence trafficability, revegetation, and the risk of pollution are the main considerations in rating the soils for area sanitary landfills.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. The ratings in Table 16, "Sanitary Facilities" are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste. The suitability of a soil for use as cover is based on properties that affect workability and the ease of digging, moving, and spreading the material over the refuse daily during both wet and dry periods.

Soil texture, wetness, rock fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Waste Management

Soil properties are important when organic waste is applied as fertilizer and wastewater is applied in irrigated areas. They also are important when the soil is used as a medium for the treatment and disposal of the organic waste and wastewater. Unfavorable soil properties can result in environmental damage.

The use of organic waste and wastewater as production resources results in energy and resource conservation and minimizes the problems associated with waste disposal. If disposal is the goal, applying a maximum amount of the organic waste or the wastewater to a minimal area holds costs to a minimum and environmental damage is the main hazard. If reuse is the goal, a minimum amount should be applied to a maximum area and environmental damage is unlikely.

Interpretations developed for waste management may include ratings for manure- and food-processing waste, municipal sewage sludge, use of wastewater for irrigation, and treatment of wastewater by slow rate, overland flow, and rapid infiltration processes.

Specific information regarding waste management is available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

Construction Materials

Table 17, "Construction Materials" gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated **good**, **fair**, or **poor** as a source of roadfill and topsoil. They are rated as a **probable** or **improbable** source of sand and gravel.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In Table 17, "Construction Materials," the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. Table 19, “Engineering Index Properties,” provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated **good** contain significant amounts of sand or gravel, or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated **fair** are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated **poor** have one or more of the following characteristics: a plasticity index of more than 10, a high shrink-swell potential, many stones, slopes of more than 25 percent, or a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In Table 17, "Construction Materials," only the probability of finding material in suitable quantity in or below the soil is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is as much as 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated **good** have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated **fair** are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated **poor** are very sandy or clayey, have less than 20 inches of suitable material, have a large

amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils generally is preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 18, "Water Management," gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered **slight** if soil properties and site features generally are favorable for the indicated use and limitations are minor and are easily overcome; **moderate** if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives, for each soil, the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In Table 18, "Water Management," the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even more than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table, permeability of the aquifer, and quality of the water as inferred from the salinity of the soil. Depth to bedrock and the content of large stones affect the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff.

Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct

surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Table 15.-Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
110:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
111:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
120:						
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Buse	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
470:						
Cresbard	Moderate: too clayey wetness	Severe: shrink-swell	Moderate: shrink-swell wetness	Severe: shrink-swell	Severe: low strength shrink-swell	Severe: excess sodium
Barnes	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
674:						
Farnuf	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
676:						
Farnuf	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
Sakakawea	Severe: cutbanks cave	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
882:						
Hamerly	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Severe: frost action	Moderate: wetness
Tonka	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
975:						
Heil	Severe: ponding cutbanks cave	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: excess sodium ponding

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
1267:						
Marysland---------------	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action wetness	Severe: wetness
1427:						
Parnell-----------------	Severe: excess humus ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
1439:						
Parshall----------------	Severe: cutbanks cave	Slight	Slight	Slight	Moderate: frost action	Slight
1466:						
Pits, sand and gravel---	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope small stones droughty
1709:						
Southam-----------------	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
1739:						
Straw-------------------	Severe: cutbanks cave	Severe: flooding	Severe: flooding	Severe: flooding	Severe: flooding	Moderate: flooding
1835:						
Tonka-------------------	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
1871:						
Vallers, saline---------	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
1883:						
Vallers-----------------	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
Parnell-----------------	Severe: excess humus ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
1978:						
Water-------------------	—	—	—	—	—	—
2014:						
Williams----------------	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Bowbells----------------	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2015:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Bowbells	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
2023:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Niobell	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Moderate: frost action low strength shrink-swell	Severe: excess sodium
2024:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Niobell	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Moderate: frost action low strength shrink-swell	Severe: excess sodium
2031:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Zahl	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
2081:						
Zahl	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: shrink-swell slope	Severe: low strength	Moderate: slope
Williams	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: shrink-swell slope	Severe: low strength	Moderate: slope
2130:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Zahl	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Parnell	Severe: excess humus ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2131:						
Zahl	Severe: slope	Severe: shrink-swell slope	Severe: shrink-swell slope	Severe: shrink-swell slope	Severe: low strength	Severe: slope
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Parnell	Severe: excess humus ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding
2169:						
Harriet	Severe: wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: excess sodium wetness
Regan	Severe: wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding low strength wetness	Severe: excess salt wetness
Stirum	Severe: wetness cutbanks cave	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding	Severe: excess sodium
2170:						
Divide	Severe: cutbanks cave	Slight	Moderate: wetness	Slight	Moderate: frost action	Slight
2171:						
Sakakawea	Severe: cutbanks cave	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Farnuf	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
2172:						
Sakakawea	Severe: slope cutbanks cave	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Farnuf	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: slope	Severe: low strength	Moderate: slope
2173:						
Marias	Severe: cutbanks cave	Severe: shrink-swell	Severe: shrink-swell	Severe: shrink-swell	Severe: low strength shrink-swell	Severe: too clayey
2174:						
Marias	Severe: cutbanks cave	Severe: shrink-swell	Severe: shrink-swell	Severe: shrink-swell	Severe: low strength shrink-swell	Severe: too clayey

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2175:						
Zahl	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
2176:						
Zahl	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Williams	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
2177:						
Zahl	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Williams	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Vallers	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: frost action	Moderate: wetness
2178:						
Farnuf	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
Alkabo	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium
2179:						
Noonan	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium
Niobell	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Moderate: frost action low strength shrink-swell	Severe: excess sodium
2180:						
Niobell	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Moderate: frost action low strength shrink-swell	Severe: excess sodium
Noonan	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium
Tonka	Severe: ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: shrink-swell ponding	Severe: low strength shrink-swell ponding	Severe: ponding

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2181:						
Miranda	Severe: wetness	Moderate: shrink-swell wetness	Severe: wetness	Moderate: shrink-swell wetness	Moderate: low strength shrink-swell wetness	Severe: excess sodium
Noonan	Moderate: wetness	Moderate: shrink-swell	Moderate: shrink-swell wetness	Moderate: shrink-swell	Severe: low strength	Severe: excess sodium
2182:						
Portal	Slight	Slight	Slight	Slight	Moderate: frost action	Severe: excess sodium
Lihen	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
2183:						
Lihen	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Blanchard	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
2184:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Zahl	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
2185:						
Williams	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: shrink-swell slope	Severe: low strength	Moderate: slope
Zahl	Moderate: slope	Moderate: shrink-swell slope	Moderate: shrink-swell slope	Severe: shrink-swell slope	Severe: low strength	Moderate: slope
Lihen	Severe: cutbanks cave	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope droughty
2186:						
Lehr	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Wabek	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe
2187:						
Appam	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
Wabek	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2188:						
Wabek	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe
Lehr	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
2189:						
Wabek	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Severe
Appam	Severe: cutbanks cave	Slight	Slight	Slight	Slight	Moderate: droughty
2190:						
Williams	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
2191:						
Towner	Severe: cutbanks cave	Slight	Moderate: shrink-swell wetness	Slight	Moderate: frost action	Moderate: droughty
Kratka	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
2192:						
Kratka	Severe: wetness cutbanks cave	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Wyndmere	Severe: wetness cutbanks cave	Moderate: wetness	Severe: wetness	Moderate: wetness	Severe: frost action	Moderate: wetness droughty
2193:						
Dumps, mine	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
Ustorthents	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope	Severe: slope
2194:						
Haplustolls	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
Ustorthents	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell	Severe: low strength	Slight
2195:						
Ustorthents	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight
Haplustolls	Slight	Moderate: shrink-swell	Moderate: shrink-swell	Moderate: shrink-swell slope	Severe: low strength	Slight

Table 15.-Building Site Development--Continued

Map symbol and soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
2227:						
Swenoda-----------------	Moderate: wetness	Slight	Moderate: shrink-swell wetness	Slight	Moderate: frost action	Slight

Table 16.-Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes (—) indicate the map unit component was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.)

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
110:					
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
111:					
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
120:					
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Buse	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
470:					
Cresbard	Severe: percs slowly	Moderate: slope wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium hard to pack
Barnes	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
674:					
Farnuf	Moderate: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Poor: hard to pack
676:					
Farnuf	Moderate: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Poor: hard to pack
Sakakawea	Moderate: percs slowly	Moderate: seepage slope	Slight	Slight	Fair: thin layer
882:					
Hamerly	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Fair: too clayey wetness
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
975:					
Heil	Severe: percs slowly ponding	Severe: ponding	Severe: excess sodium too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1267:					
Marysland	Severe: percs slowly wetness	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Poor: seepage small stones too sandy
1427:					
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1439:					
Parshall	Slight	Severe: seepage	Severe: seepage	Severe: seepage	Fair: too sandy
1466:					
Pits, sand and gravel	Severe: slope poor filter	Severe: seepage slope	Severe: seepage slope too sandy	Severe: seepage slope	Poor: seepage small stones too sandy
1709:					
Southam	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1739:					
Straw	Severe: flooding	Severe: flooding seepage	Severe: flooding seepage	Severe: flooding seepage	Fair: too clayey
1835:					
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1871:					
Vallers, saline	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
1883:					
Vallers	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
1978:					
Water	—	—	—	—	—
2014:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Bowbells	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2015:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Bowbells	Severe: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Fair: too clayey
2023:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Niobell	Severe: percs slowly wetness	Moderate: slope wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
2024:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Niobell	Severe: percs slowly wetness	Moderate: slope wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
2031:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Zahl	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
2081:					
Zahl	Severe: percs slowly	Severe: seepage slope	Moderate: slope too clayey	Moderate: slope	Fair: too clayey
Williams	Severe: percs slowly	Severe: seepage slope	Moderate: slope too clayey	Moderate: slope	Fair: too clayey
2130:					
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Zahl	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
2131:					
Zahl	Severe: percs slowly	Severe: seepage slope	Severe: slope too clayey	Severe: slope	Fair: too clayey
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2131:(cont.)					
Parnell	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
2169:					
Harriet	Severe: flooding percs slowly wetness	Severe: flooding	Severe: flooding too clayey wetness	Severe: flooding wetness	Poor: hard to pack too clayey wetness
Regan	Severe: flooding percs slowly wetness	Severe: flooding wetness	Severe: flooding wetness	Severe: flooding wetness	Poor: wetness
Stirum	Severe: flooding wetness poor filter	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Severe: flooding seepage wetness	Poor: excess sodium wetness
2170:					
Divide	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage wetness	Severe: seepage wetness	Poor: seepage small stones too sandy
2171:					
Sakakawea	Moderate: percs slowly	Severe: slope	Slight	Slight	Fair: thin layer
Farnuf	Moderate: percs slowly	Severe: slope	Moderate: too clayey	Slight	Poor: hard to pack
2172:					
Sakakawea	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Farnuf	Moderate: percs slowly slope	Severe: slope	Moderate: slope too clayey	Moderate: slope	Poor: hard to pack
2173:					
Marias	Severe: percs slowly	Slight	Severe: too clayey	Slight	Poor: hard to pack too clayey
2174:					
Marias	Severe: percs slowly	Slight	Severe: too clayey	Slight	Poor: hard to pack too clayey
2175:					
Zahl	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Williams	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2176:					
Zahl	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Williams	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
2177:					
Zahl	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Williams	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Vallers	Severe: percs slowly wetness	Severe: wetness	Severe: wetness	Severe: wetness	Poor: wetness
2178:					
Farnuf	Moderate: percs slowly	Moderate: seepage	Moderate: too clayey	Slight	Poor: hard to pack
Alkabo	Severe: percs slowly	Slight	Severe: excess sodium	Slight	Poor: excess sodium hard to pack
2179:					
Noonan	Severe: percs slowly wetness	Moderate: slope	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
Niobell	Severe: percs slowly wetness	Moderate: slope wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
2180:					
Niobell	Severe: percs slowly wetness	Moderate: slope wetness	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
Noonan	Severe: percs slowly wetness	Slight	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium
Tonka	Severe: percs slowly ponding	Severe: ponding	Severe: too clayey ponding	Severe: ponding	Poor: hard to pack too clayey ponding
2181:					
Miranda	Severe: percs slowly wetness	Slight	Severe: excess sodium wetness	Severe: wetness	Poor: excess sodium
Noonan	Severe: percs slowly wetness	Slight	Severe: excess sodium wetness	Moderate: wetness	Poor: excess sodium

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2182:					
Portal	Slight	Severe: seepage	Severe: excess sodium seepage	Severe: seepage	Poor: excess sodium
Lihen	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: too sandy
2183:					
Lihen	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: too sandy
Blanchard	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: too sandy
2184:					
Williams	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Zahl	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
2185:					
Williams	Severe: percs slowly	Severe: seepage slope	Moderate: slope too clayey	Moderate: slope	Fair: too clayey
Zahl	Severe: percs slowly	Severe: seepage slope	Moderate: slope too clayey	Moderate: slope	Fair: too clayey
Lihen	Severe: poor filter	Severe: seepage slope	Severe: seepage too sandy	Severe: seepage	Poor: too sandy
2186:					
Lehr	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
Wabek	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
2187:					
Appam	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
Wabek	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2188:					
Wabek	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
Lehr	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
2189:					
Wabek	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
Appam	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Poor: seepage small stones too sandy
2190:					
Williams	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
2191:					
Towner	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness
Kratka	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
2192:					
Kratka	Severe: percs slowly wetness poor filter	Severe: seepage wetness	Severe: wetness	Severe: seepage wetness	Poor: wetness
Wyndmere	Severe: wetness poor filter	Severe: seepage wetness	Severe: seepage too sandy wetness	Severe: seepage wetness	Poor: too sandy
2193:					
Dumps, mine	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope
Ustorthents	Severe: percs slowly slope	Severe: slope	Severe: slope	Severe: slope	Poor: slope

Table 16.-Sanitary Facilities--Continued

Map symbol and soil name	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
2194:					
Haplustolls	Severe: percs slowly	Moderate: seepage slope	Moderate: too clayey	Slight	Fair: too clayey
Ustorthents	Severe: percs slowly	Moderate: slope	Moderate: too clayey	Slight	Fair: too clayey
2195:					
Ustorthents	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
Haplustolls	Severe: percs slowly	Severe: slope	Moderate: too clayey	Slight	Fair: too clayey
2227:					
Swenoda	Severe: percs slowly wetness	Severe: seepage wetness	Moderate: too clayey wetness	Severe: seepage	Fair: too clayey wetness

Table 17.—Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," or other terms. Dashes (—) indicate the map unit component was not rated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
110:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
111:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
120:				
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Buse	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
470:				
Cresbard	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium too clayey
Barnes	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones
674:				
Farnuf	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
676:				
Farnuf	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
Sakakawea	Fair: shrink-swell	Improbable: excess fines	Improbable: excess fines	Good
882:				
Hamerly	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
975:				
Heil	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt too clayey wetness
1267:				
Marysland	Poor: wetness	Probable	Probable	Poor: area reclaim small stones wetness

Table 17.—Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
1427:				
Parnell	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1439:				
Parshall	Good	Improbable: excess fines	Improbable: excess fines	Good
1466:				
Pits, sand and gravel	Poor: slope	Probable	Probable	Poor: area reclaim small stones too sandy
1709:				
Southam	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1739:				
Straw	Good	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1835:				
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
1871:				
Vallers, saline	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
1883:				
Vallers	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
Parnell	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
1978:				
Water	—	—	—	—
2014:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Bowbells	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2015:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey

Table 17.--Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2015:(cont.)				
Bowbells	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2023:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Niobell	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
2024:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Niobell	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
2031:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2081:				
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
2130:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Parnell	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
2131:				
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey

Table 17.—Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2131:(cont.)				
Parnell-----------------	Poor: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: wetness
2169:				
Harriet-----------------	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt too clayey wetness
Regan-------------------	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess salt wetness
Stirum------------------	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium excess salt
2170:				
Divide------------------	Fair: wetness	Probable	Probable	Poor: area reclaim small stones too sandy
2171:				
Sakakawea---------------	Fair: shrink-swell	Improbable: excess fines	Improbable: excess fines	Good
Farnuf------------------	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
2172:				
Sakakawea---------------	Fair: shrink-swell slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Farnuf------------------	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: slope too clayey
2173:				
Marias------------------	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
2174:				
Marias------------------	Poor: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: too clayey
2175:				
Zahl--------------------	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Williams----------------	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey

Table 17.—Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2176:				
Zahl	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Williams	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
2177:				
Zahl	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Williams	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Vallers	Fair: low strength wetness	Improbable: excess fines	Improbable: excess fines	Fair: small stones
2178:				
Farnuf	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: too clayey
Alkabo	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
2179:				
Noonan	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
Niobell	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
2180:				
Niobell	Fair: low strength shrink-swell	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
Noonan	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
Tonka	Poor: low strength wetness	Improbable: excess fines	Improbable: excess fines	Poor: too clayey wetness
2181:				
Miranda	Fair: low strength shrink-swell wetness	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium excess salt
Noonan	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium
2182:				
Portal	Good	Improbable: excess fines	Improbable: excess fines	Poor: excess sodium excess salt

Table 17.—Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2182:(cont.)				
Lihen	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
2183:				
Lihen	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
Blanchard	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
2184:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
2185:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Zahl	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones too clayey
Lihen	Good	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
2186:				
Lehr	Good	Probable	Probable	Poor: area reclaim small stones too sandy
Wabek	Good	Probable	Probable	Poor: area reclaim small stones
2187:				
Appam	Good	Probable	Probable	Poor: area reclaim small stones too sandy
Wabek	Good	Probable	Probable	Poor: area reclaim small stones
2188:				
Wabek	Good	Probable	Probable	Poor: area reclaim small stones
Lehr	Good	Probable	Probable	Poor: area reclaim small stones too sandy

Table 17.—Construction Materials--Continued

Map symbol and soil name	Roadfill	Sand	Gravel	Topsoil
2189:				
Wabek	Good	Probable	Probable	Poor: area reclaim small stones
Appam	Good	Probable	Probable	Poor: area reclaim small stones too sandy
2190:				
Williams	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
2191:				
Towner	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Poor: too sandy
Kratka	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
2192:				
Kratka	Poor: wetness	Improbable: excess fines	Improbable: excess fines	Poor: thin layer wetness
Wyndmere	Fair: wetness	Improbable: excess fines	Improbable: excess fines	Fair: thin layer
2193:				
Dumps, mine	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
Ustorthents	Poor: low strength slope	Improbable: excess fines	Improbable: excess fines	Poor: slope
2194:				
Haplustolls	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Ustorthents	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
2195:				
Ustorthents	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
Haplustolls	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: large stones too clayey
2227:				
Swenoda	Poor: low strength	Improbable: excess fines	Improbable: excess fines	Fair: small stones

Table 18.-Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Dashes (—) indicate that the map unit component was not evaluated.) The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation.

Map symbol and soil name	Limitations for—			Features affecting—			
	Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Drainage	Irrigation	Terraces and diversions	Grassed waterways
110:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
111:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
120:							
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Buse	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
470:							
Cresbard	Slight	Severe: excess sodium	Severe: slow refill	Limitation: deep to water	Limitation: excess sodium percs slowly	Favorable	Limitation: excess sodium percs slowly
Barnes	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
674:							
Farnuf	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Favorable	Favorable
676:							
Farnuf	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Favorable	Favorable
Sakakawea	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Favorable	Favorable
882:							
Hamerly	Moderate: seepage	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: erodes easily wetness	Limitation: erodes easily
Tonka	Slight	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
975:							
Heil	Slight	Severe: excess sodium hard to pack ponding	Severe: no water	Limitation: excess salt percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily excess sodium wetness

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
1267:							
Marysland	Severe: seepage	Severe: seepage wetness	Severe: slow refill cutbanks cave	Limitation: frost action cutbanks cave	Limitation: wetness	Limitation: too sandy wetness	Limitation: wetness
1427:							
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
1439:							
Parshall	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: too sandy soil blowing	Favorable
1466:							
Pits, sand and gravel	Severe: seepage slope	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: slope too sandy	Limitation: slope droughty
1709:							
Southam	Slight	Severe: thin layer ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily excess salt wetness
1739:							
Straw	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: flooding	Favorable	Favorable
1835:							
Tonka	Slight	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
1871:							
Vallers, saline	Slight	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness
1883:							
Vallers	Slight	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
1978:							
Water	—	—	—	—	—	—	—
2014:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2014:(cont.)							
Bowbells	Moderate: seepage	Moderate: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
2015:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Bowbells	Moderate: seepage	Moderate: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
2023:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Favorable	Limitation: erodes easily	Limitation: erodes easily
Niobell	Moderate: slope	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly slope	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly
2024:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Niobell	Moderate: slope	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly slope	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly
2031:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2081:							
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2130:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2131:							
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Parnell	Slight	Severe: hard to pack ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
2169:							
Harriet	Moderate: seepage	Severe: excess sodium piping wetness	Severe: slow refill	Limitation: flooding frost action percs slowly	Limitation: percs slowly wetness	Limitation: erodes easily wetness	Limitation: erodes easily excess sodium wetness
Regan	Moderate: seepage	Severe: wetness	Severe: slow refill	Limitation: excess salt flooding frost action	Limitation: excess salt flooding wetness	Limitation: wetness	Limitation: excess salt wetness
Stirum	Severe: seepage	Severe: seepage piping wetness	Severe: slow refill cutbanks cave	Limitation: excess salt flooding cutbanks cave	Limitation: wetness droughty	Limitation: too sandy wetness soil blowing	Limitation: excess sodium excess salt wetness
2170:							
Divide	Severe: seepage	Severe: seepage piping	Severe: cutbanks cave	Limitation: cutbanks cave	Limitation: wetness	Limitation: too sandy wetness	Favorable
2171:							
Sakakawea	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Favorable	Favorable
Farnuf	Moderate: seepage slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Favorable	Favorable
2172:							
Sakakawea	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: slope	Limitation: slope
Farnuf	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: slope	Limitation: slope
2173:							
Marias	Slight	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: percs slowly slow intake	Limitation: erodes easily percs slowly	Limitation: erodes easily percs slowly
2174:							
Marias	Slight	Severe: hard to pack	Severe: no water	Limitation: deep to water	Limitation: percs slowly slow intake	Limitation: erodes easily percs slowly	Limitation: erodes easily percs slowly

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2175:							
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2176:							
Zahl	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Williams	Severe: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
2177:							
Zahl	Severe: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Williams	Severe: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Vallers	Slight	Severe: piping wetness	Severe: slow refill	Limitation: frost action	Limitation: wetness	Limitation: wetness	Limitation: wetness
2178:							
Farnuf	Moderate: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Favorable	Favorable	Favorable
Alkabo	Slight	Severe: excess sodium	Severe: no water	Limitation: deep to water	Limitation: excess sodium excess salt percs slowly	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly
2179:							
Noonan	Moderate: slope	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly slope	Limitation: erodes easily percs slowly	Limitation: erodes easily excess sodium percs slowly
Niobell	Moderate: slope	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly slope	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly
2180:							
Niobell	Moderate: slope	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly slope	Limitation: erodes easily	Limitation: erodes easily excess sodium percs slowly
Noonan	Slight	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly	Limitation: erodes easily percs slowly	Limitation: erodes easily excess sodium percs slowly

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
2180:(cont.)							
Tonka	Slight	Severe: ponding	Severe: slow refill	Limitation: frost action percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly ponding	Limitation: erodes easily percs slowly wetness
2181:							
Miranda	Slight	Severe: excess sodium piping	Severe: slow refill	Limitation: excess salt percs slowly	Limitation: percs slowly wetness	Limitation: percs slowly wetness	Limitation: excess sodium percs slowly
Noonan	Slight	Severe: excess sodium piping	Severe: slow refill	Limitation: deep to water	Limitation: percs slowly	Limitation: erodes easily percs slowly	Limitation: erodes easily excess sodium percs slowly
2182:							
Portal	Severe: seepage	Severe: excess sodium piping	Severe: no water	Limitation: deep to water	Limitation: soil blowing droughty	Limitation: soil blowing	Limitation: excess sodium droughty
Lihen	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
2183:							
Lihen	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
Blanchard	Severe: seepage	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: fast intake slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
2184:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2185:							
Williams	Moderate: seepage slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Zahl	Moderate: slope	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Lihen	Severe: seepage slope	Severe: seepage piping	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: slope too sandy soil blowing	Limitation: slope droughty
2186:							
Lehr	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy	Limitation: droughty

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for— Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting— Drainage	Irrigation	Terraces and diversions	Grassed waterways
2186:(cont.)							
Wabek	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
2187:							
Appam	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
Wabek	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
2188:							
Wabek	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
Lehr	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy	Limitation: droughty
2189:							
Wabek	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope droughty	Limitation: too sandy soil blowing	Limitation: droughty
Appam	Severe: seepage	Severe: seepage	Severe: no water	Limitation: deep to water	Limitation: slope soil blowing droughty	Limitation: too sandy soil blowing	Limitation: droughty
2190:							
Williams	Moderate: seepage	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily
2191:							
Towner	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: fast intake droughty	Limitation: erodes easily soil blowing	Limitation: erodes easily droughty
Kratka	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Favorable	Limitation: wetness droughty	Limitation: wetness soil blowing	Limitation: rooting depth wetness droughty
2192:							
Kratka	Severe: seepage	Severe: piping wetness	Severe: slow refill cutbanks cave	Favorable	Limitation: wetness droughty	Limitation: wetness soil blowing	Limitation: rooting depth wetness droughty
Wyndmere	Severe: seepage	Severe: piping wetness	Severe: cutbanks cave	Limitation: frost action cutbanks cave	Limitation: wetness droughty	Limitation: too sandy wetness soil blowing	Limitation: droughty

Table 18.-Water Management--Continued

Map symbol and soil name	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Aquifer-fed excavated ponds	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
2193:							
Dumps, mine	Severe: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily slope	Limitation: erodes easily slope
Ustorthents	Severe: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: excess salt slope	Limitation: erodes easily slope	Limitation: erodes easily slope
2194:							
Haplustolls	Moderate: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
Ustorthents	Moderate: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: excess salt slope	Limitation: erodes easily	Limitation: erodes easily
2195:							
Ustorthents	Moderate: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: excess salt slope	Limitation: erodes easily	Limitation: erodes easily
Haplustolls	Moderate: slope	Moderate: piping	Severe: no water	Limitation: deep to water	Limitation: slope	Limitation: erodes easily	Limitation: erodes easily
2227:							
Swenoda	Severe: seepage	Severe: piping	Severe: no water	Limitation: deep to water	Limitation: soil blowing	Limitation: erodes easily soil blowing	Limitation: erodes easily

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and estimates of soil and water features listed in tables are explained on the following pages.

Soil properties are determined by or estimated from the field examination of soils and laboratory testing. During the survey, many shallow borings are made and examined to identify and classify soils and delineate them on soil maps. Samples are taken from some typical soils and tested in the laboratory to determine physical and chemical soil properties. Standard laboratory procedures are followed. Information from the laboratory and results from samples from similar soils in nearby areas are used to verify field observations and properties that cannot be estimated accurately in the field. The laboratory analyses also help to characterize key soils.

Estimates of soil properties shown in the tables include the range of soil texture, Atterberg limits, engineering classifications, and other physical and chemical properties of the major layers of each soil. Pertinent soil and water features are also given.

Each soil map unit was documented by at least one pedon description for each soil series identified in its name. Pedons were sampled for engineering properties. The analyses were made by the North Dakota State Department of Transportation.

Engineering Index Properties

Table 19, "Engineering Index Properties," gives estimates of the engineering classification and range of index properties for major layers of each named map unit component in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions of this publication, under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 1993) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 1986).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups, from A-1 through A-7, on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6.

Rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. Estimates are based on test data from the survey area or from nearby areas and on field examination.

Estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical Properties

Table 20, "Physical Properties of the Soils," shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and test data for these and similar soils.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions of this publication, under the heading "Soil Series and Their Morphology."

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. Clay determines the ability of soil to adsorb cations and retain moisture. Clay influences shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In Table 20, "Physical Properties of the Soils," the estimated range in moist bulk density of each major soil layer is expressed in grams per cubic centimeter of soil material less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. Moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, organic matter content, and soil structure.

Ksat (permeability/saturated hydraulic conductivity) refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water the soil is capable of storing for use by plants. The range in the capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect retention of water and depth of the root zone. The most important soil properties are organic matter content, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain of moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The magnitude of the load on the soil and magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design features are often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The

classes are **low**, a change of less than 3 percent; **moderate**, 3 to 6 percent; and **high**, more than 6 percent. **Very high**, more than 9 percent, is sometimes used.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In Table 20, "Physical Properties of the Soils," the estimated range in organic matter content is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects available water capacity, infiltration rates, and tilth. It is a source of nitrogen and other nutrients for crops.

Erosion factor Kw indicates the susceptibility of a soil to sheet and rill erosion by water. Soil properties that influence erodibility are those that affect the infiltration rate, movement of water though the soil, water storage capacity of the soil, and those that allow the soil to resist dispersion, splashing, abrasion, and the transporting forces of rainfall and runoff. The most important soil properties are the content of silt, sand, and organic matter and soil structure and permeability. The factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are modified by the presence of rock fragments. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion.

Erosion factor Kf is similar to the erosion factor K, except it indicates the erodibility of only the fine-earth fraction, or the material less than 2 millimeters in size.

Soil-loss tolerance factor T is an estimate of the maximum annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is expressed in tons per acre per year. Ratings of 1 to 5 are used depending on soil properties and prior erosion. The criteria used in assigning a T factor to a soil include maintenance of an adequate rooting depth for crop production, potential reduction of crop yields, maintenance of water-control structures affected by sedimentation, prevention of gullying, and the value of nutrients lost through erosion.

Wind erodibility groups (WEG) are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion. Soils are grouped according to the following distinctions:

WEG 1. Coarse sands, sands, fine sands, and very fine sands. These soils generally are not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

WEG 2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

WEG 4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are highly erodible. Crops can be grown if measures to control wind erosion are used.

WEG 5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

WEG 6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control wind erosion are used.

WEG 8. Soils that are not subject to soil blowing because of rock fragments on the surface or because of surface wetness.

Wind erodibility index (I) is a numerical value indicating the potential annual soil loss due to wind erosion for a soil under a well defined set of climatic and management conditions. This factor is expressed as the average annual soil loss in tons per acre per year.

Chemical Properties

Table 21, "Chemical Properties of the Soils," shows estimates of some soil chemical properties that affect soil behavior. These estimates are given for the major layers of each named map unit component in the

survey area. The estimates are based on test data for these and similar soils. These features are described in the following paragraphs.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given in the series descriptions of this publication, under the heading "Soil Series and Their Morphology."

Clay consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material less than 2 millimeters in diameter.

Cation-exchange capacity is the total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. Soils having a low cation-exchange capacity hold fewer cations and may require more frequent applications of fertilizer than soils having a high cation-exchange capacity. The ability to retain cations helps to prevent pollution of ground water.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Calcium carbonate equivalent is the percent of carbonates, by weight, in the soil. The availability of plant nutrients is influenced by the amount of carbonates in the soil. Incorporating nitrogen fertilizer into calcareous soils helps to prevent nitrite accumulation and ammonium-N volatilization. Calcium carbonate also affects susceptibility of a soil to wind erosion.

Gypsum is given as the percent, by weight, of hydrated calcium sulfates in the soil. Gypsum is partially soluble in water and can be dissolved and removed by water. Soils that have a high content of gypsum (more than 10 percent) may collapse if the gypsum is removed by percolating water.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity (EC) of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of the soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Sodium adsorption ratio (SAR) is the measure of sodium relative to calcium and magnesium in the water extract from a saturated soil paste. Soils having a sodium adsorption ratio of 13 or more may be characterized by an increased dispersion of organic matter and clay particles, reduced permeability and aeration, and a general degradation of soil structure.

Water Features

Table 22, "Water Features," gives estimates of several important water features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Hydrologic soil groups are groups of soils that have the same runoff potential under similar storm and ground cover conditions. Soil properties that affect the runoff potential are those that influence the rate of infiltration in a bare soil after prolonged wetting and when the soil is not frozen. These properties include the depth to a seasonal high water table, the intake rate, permeability after prolonged wetting, and the depth to a very slowly permeable layer. The influences of ground cover and slope are treated independently and are not taken into account in hydrologic soil groups.

In the definitions of the hydrologic soil groups, the infiltration rate is the rate at which water enters the soil at the surface and is controlled by surface conditions. The transmission rate is the rate at which water moves through the soil and is controlled by properties of the soil layers.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of very deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist mainly of moderately deep or deep, moderately well or well drained soils that have moderately fine to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist mainly of soils having a layer that impedes the downward movement of water or soils that have a moderately fine or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist mainly of clayey soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups, the first letter is for drained areas and the second is for undrained areas.

Water table (seasonal) refers to a zone in an unaltered or undrained soil that is at saturation in most years. It is at least 6 inches thick, persists in the soil for more than a few weeks, and is within 6 feet of the surface. Estimates of water table depths are based mainly on the evidence of a saturated zone that exists in a soil, namely a combination of grayish colors or redoximorphic features. Water tables may either be apparent or perched. An apparent water table is indicated by the level at which water stands in a freshly dug, unlined borehole after adequate time is allowed for adjustments in the surrounding soil. A perched water table is water standing above an unsaturated zone in the soil. A perched water table may be separated from a lower water table by an unsaturated zone. Water tables usually are perched by textural discontinuities in the soil profile. A perched water table may be confirmed if the water level in a borehole falls when the borehole is extended.

Indicated in Table 22, "Water Features," are the **upper limit** and **lower limit** in the depth of the water table found in the soil in most years. These depth ranges are given to the nearest tenth of a foot and are listed by month. If no water table exists in the soil, no information is given.

Ponding is standing water in a closed depression. Unless a drainage system is installed, the water is removed only by percolation, transpiration, or evaporation. Ponding of soils is classified according to the depth, duration, frequency, and the beginning and ending months in which water is observed.

Surface water depth is the maximum depth of surface water that is ponded on the soil.

Ponding duration is the average length of time of the ponding occurrence. Ponding duration classes are **very brief** (less than 2 days), **brief** (2 to 7 days), **long** (7 to 30 days), or **very long** (more than 30 days).

Ponding frequency is the number of times ponding occurs over a period of time. Ponding frequency classes are **none** (no reasonable possibility of ponding), **rare** (ponding unlikely but possible under unusual weather conditions; 0 to 5 percent chance of ponding in any year); **occasional** (ponding is expected infrequently under usual weather conditions; 5 to 50 percent chance of ponding in any year); and **frequent** (ponding is likely to occur under usual weather conditions; more than 50 percent chance in any year).

Flooding, the temporary covering of the soil surface by flowing water, is caused by overflow from streams or by runoff from adjacent slopes. Shallow water standing or flowing for short periods after rainfall or snowmelt is not considered flooding. Standing water in marshes and swamps or in closed depressions is considered to be ponding.

Table 22, "Water Features," gives the **duration** and **frequency** of flooding and the time of year when flooding is most likely to occur. Flooding frequency classes are identical to ponding frequency classes. Flooding duration classes are **extremely brief** (0.1 to 4 hours), **very brief** (4 to 48 hours), **brief** (2 to 7 days), **long** (7 to 30 days), and **very long** (more than 30 days). Frequency, duration, and probable dates of occurrence are estimated.

The information on flooding is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered in making flooding estimates are local information about the extent and level of flooding and the relation of each soil on the landscape to historic floods. It is assumed the soil is unprotected by dikes, levees, or dams. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Soil Features

Table 23, "Soil Features," gives estimates of several important soil features used in land use planning that involves engineering considerations. These features are described in the following paragraphs.

Restrictive layers are nearly continuous soil layers that significantly reduce the movement of water and air through the soil or that otherwise provide an unfavorable root environment. Restriction **kind** is the

type of restriction. Examples of restrictions include bedrock, cemented layers, and dense layers. Restriction **thickness** is the distance from the top to the bottom of a restrictive layer. Restriction **hardness** refers to the rupture resistance or strength of the layer.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, organic matter content, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly-structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

A **low** potential for frost action indicates that the soil is rarely susceptible to the formation of ice lenses; a **moderate** potential indicates that the soil is susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength; and a **high** potential indicates that the soil is highly susceptible to formation of ice lenses, resulting in frost heave and the subsequent loss of soil strength.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil.

Special site examination and design features may be needed if the combination of factors results in a severe hazard of corrosion. Steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For **uncoated steel**, the risk of corrosion, expressed as **low**, **moderate**, or **high**, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For **concrete**, the risk of corrosion is also expressed as **low**, **moderate**, or **high**. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Hydric Soils

Table 24, "Hydric Soils List," shows which map units have components that meet the definition of hydric soils in Burke County. This table can help in planning land uses; however, onsite investigation is recommended to determine the hydric soils on a specific site (National Research Council, 1995; USDA-NRCS, 1996.) Map units that are made up of hydric soils may have small areas or inclusions, of nonhydric soils in the higher positions on the landform, and map units made up of nonhydric soils may have inclusions of hydric soils in the lower positions of the landform.

Three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology (Cowardin, et al., 1979; Environmental Laboratory, 1987; National Research Council, 1995; Tiner, 1985). Criteria for each of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands.

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria which identify those estimated soil properties unique to hydric soils have been established (Federal Register, 1995.) These criteria are used to identify a phase of a soil series that normally is associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999)

and in the "Soil Survey Manual" (Soil Survey Staff, 1993.)

If soils are wet enough for a long enough period to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators that can be used to make onsite determinations of hydric soils in Burke County are specified in "Field Indicators of Hydric Soils in the United States" (USDA-NRCS, 1996).

Hydric soils are identified by examining and describing the soil to a depth of about 20 inches. This depth may be greater if determination of an appropriate indicator so requires. It is always recommended that soils be excavated and described as deep as necessary to understand the redoximorphic processes. Then, using the completed soil description, soil scientists can compare soil features required by each hydric soil indicator and specify which indicators have been matched with the conditions observed in the soil. The soil can be identified as a hydric soil if one (or more) of the approved indicators is present.

This survey can be used to locate probable areas of hydric soils. The hydric soil may have been artificially drained or otherwise altered such that it no longer supports a predominance of hydrophytic vegetation. The soil map does not identify drained areas.

Table 19.-Engineering Index Properties

(The symbol < means less than; > means greater than. Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
110:												
Barnes----------	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	19-37	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	37-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
111:												
Barnes----------	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	19-37	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	37-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
120:												
Barnes----------	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	19-37	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	37-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
Buse------------	0-8	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	90-100	85-95	60-75	25-35	10-15
	8-40	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	40-60	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-5	90-100	85-100	70-90	55-85	25-45	10-25
470:												
Cresbard--------	0-9	Loam	ML, CL	A-6, A-4	0	0	100	100	85-100	60-80	30-40	5-15
	9-14	Clay loam, loam	CL, ML	A-4, A-6	0	0	100	100	85-100	60-80	30-40	5-15
	14-34	Clay loam, silty clay, clay	CH, CL	A-6, A-7	0	0	95-100	90-100	90-100	65-85	30-60	15-30
	34-55	Clay loam, silty clay, clay	CH, CL	A-7	0	0	95-100	90-100	85-100	65-85	40-60	15-30
	55-60	Clay loam, loam	CH, CL	A-6, A-7	—	0-5	95-100	90-100	85-100	50-80	25-55	10-27
Barnes----------	0-7	Loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	80-100	60-80	25-35	10-20
	7-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	19-37	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
	37-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	0-5	90-100	85-100	75-95	55-80	25-45	10-25
674:												
Farnuf----------	0-9	Loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-95	70-80	25-40	5-20
	9-23	Loam, clay loam	CL	A-6, A-7	0	0	100	100	80-95	55-85	30-50	15-25
	23-34	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	100	100	80-95	70-95	35-50	15-25
	34-60	Stratified fine sandy loam to silty clay loam	CH, CL, CL-ML	A-4, A-7, A-6	0	0	100	100	75-100	70-100	25-55	5-30
676:												
Farnuf----------	0-9	Loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-95	70-80	25-40	5-20
	9-23	Loam, clay loam	CL	A-6, A-7	0	0	100	100	80-95	55-85	30-50	15-25
	23-34	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	100	100	80-95	70-95	35-50	15-25
	34-60	Stratified fine sandy loam to silty clay loam	CH, CL-ML, CL	A-4, A-7, A-6	0	0	100	100	75-100	70-100	25-55	5-30

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
676:(cont.)												
Sakakawea-------	0-6	Loam	CL, CL-ML, ML	A-4, A-6	0	0	100	95-100	80-95	55-75	25-40	5-20
	6-21	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	21-41	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	41-60	Stratified loamy sand to silty clay	ML, CL, SC, SM	A-2, A-6, A-4	0	0	100	95-100	50-100	10-85	15-40	NP-25
882:												
Hamerly---------	0-8	Loam	CL, CL-ML	A-4, A-6	0	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	8-35	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	80-95	60-75	20-45	5-25
	35-60	Loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0	0-5	95-100	90-100	75-95	55-75	20-45	5-25
Tonka-----------	0-13	Silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	13-19	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	19-34	Silty clay loam, clay loam, clay	CH, CL	A-6, A-7	0-1	0-2	100	95-100	90-100	75-95	35-55	15-35
	34-50	Silty clay loam, clay loam, loam	CL, CL-ML	A-4, A-7, A-6	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
	50-60	Silty clay loam, clay loam, loam	CL, CL-ML	A-4, A-7, A-6	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
975:												
Heil------------	0-3	Silt loam	CL	A-6, A-7	0	0	100	100	90-100	70-100	25-45	10-25
	3-24	Silty clay, clay	CH	A-7	0	0	100	100	90-100	75-100	50-75	25-45
	24-38	Silty clay, clay, silty clay loam, clay loam	CH	A-7	0	0	100	100	90-100	70-95	45-65	20-40
	38-52	Silty clay, clay, silty clay loam, clay loam	CH	A-7	0	0	100	100	90-100	70-95	45-65	20-40
	52-60	Silty clay, silty clay loam, loam, clay, clay loam	CH, CL	A-6, A-7	0	0	100	100	85-100	60-95	35-65	15-40
1267:												
Marysland-------	0-9	Loam	CL	A-4, A-6, A-7	0	0-5	95-100	95-100	85-95	50-80	25-50	10-25
	9-12	Loam	CL	A-6, A-4, A-7	0	0-5	95-100	95-100	85-95	50-80	25-50	10-25
	12-15	Loam, clay loam, sandy clay loam	CL, SC	A-6, A-7	0	0-5	90-100	85-100	80-95	45-80	20-45	10-20
	15-20	Loam, clay loam, sandy clay loam	CL, SC	A-6, A-7	0	0-5	90-100	85-100	80-95	45-80	20-45	10-20
	20-27	Loam, clay loam, sandy clay loam	CL, SC	A-6, A-7	0	0-5	90-100	85-100	80-95	45-80	20-45	10-20
	27-40	Stratified fine sand to gravelly coarse sand	SP-SM, SM, GP-GM	A-3, A-2, A-1	0	0-5	50-95	35-90	35-70	5-20	0-15	NP-5
	40-60	Stratified fine sand to gravelly coarse sand	GP-GM, SP-SM, SM	A-1, A-2, A-3	0	0-5	50-95	35-90	35-70	5-20	0-15	NP-5

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
1427:												
Parnell---------	0-15	Silty clay loam	CL, OL, CH	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	15-22	Silt loam, silty clay loam	CL, CH, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	22-32	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	32-55	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	55-60	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
1439:												
Parshall--------	0-12	Fine sandy loam, sandy loam	ML, SC, CL-ML, SM	A-2, A-4	0	0	100	100	60-85	30-55	15-25	NP-10
	12-29	Fine sandy loam	ML, CL-ML, SC, SM	A-2, A-4	0	0	100	100	60-85	30-55	15-25	NP-10
	29-48	Fine sandy loam, loamy sand, sandy loam	ML, CL-ML, SC, SM	A-2, A-4	0	0	100	100	60-85	25-55	15-25	NP-10
	48-60	Loamy fine sand, fine sandy loam, sandy loam, loamy sand	ML, CL-ML, SC, SM	A-2, A-4	0	0	100	100	60-85	25-55	15-25	NP-10
1466:												
Pits, sand and gravel---------	0-6	Extremely gravelly sand	GW-GM, SW-SM	A-1, A-3	0	0-5	25-90	10-65	5-35	0-25	0-15	NP-5
	6-60	Extremely gravelly sand, extremely gravelly coarse sand, gravelly coarse sandy loam	GW-GM, SW-SM	A-1, A-3	0	0-10	25-90	10-65	5-35	0-25	0-15	NP-5
1709:												
Southam---------	0-16	Silt loam	CL, CL-ML, OL	A-6	0	0	100	95-100	90-100	85-100	30-40	10-20
	16-40	Silty clay, clay, silty clay loam	CH, CL	A-7	0	0	100	95-100	90-100	85-100	50-65	30-40
	40-60	Silty clay, silty clay loam, loam	CH, CL-ML, CL	A-6, A-7	0	0-1	100	95-100	85-100	60-100	35-65	15-40

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
1739:												
Straw-----------	0-5	Loam, silt loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-100	60-90	20-30	5-10
	5-23	Loam, silt loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-100	60-90	20-30	5-10
	23-30	Silty clay loam, loam, silt loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-100	60-90	30-45	10-25
	30-36	Clay loam, silt loam, loam	CL-ML, CL	A-6, A-4	0	0	95-100	90-100	85-100	60-90	15-40	3-20
	36-40	Silty clay loam, loam, silt loam, clay loam	CL, CL-ML	A-4, A-6	0	0	95-100	90-100	85-100	60-90	30-45	10-25
	40-66	Silt loam, clay loam, loam	CL-ML, CL	A-6, A-4	0	0	95-100	90-100	85-100	60-90	15-40	3-20
1835:												
Tonka-----------	0-13	Silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	13-19	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	19-34	Silty clay loam, clay loam, clay	CH, CL	A-6, A-7	0-1	0-2	100	95-100	90-100	75-95	35-55	15-35
	34-50	Silty clay loam, clay loam, loam	CL, CL-ML	A-4, A-7, A-6	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
	50-60	Silty clay loam, clay loam, loam	CL, CL-ML	A-7, A-6, A-4	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
1871:												
Vallers, saline-	0-9	Silt loam, loam	CL-ML, ML	A-4	0-1	0-5	95-100	90-100	80-90	50-80	30-40	4-10
	9-44	Clay loam, silty clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	50-80	30-40	11-20
	44-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-85	20-40	5-20
1883:												
Vallers---------	0-9	Silt loam, loam	CL-ML, ML	A-4	0-1	0-5	95-100	90-100	80-90	50-80	30-40	4-10
	9-44	Clay loam, silty clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	50-80	30-40	11-20
	44-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-85	20-40	5-20
Parnell---------	0-15	Silty clay loam	CH, CL, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	15-22	Silt loam, silty clay loam	CH, OL, CL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	22-32	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	32-55	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	55-60	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments >10 inches	Fragments 3-10 inches	Percentage passing sieve number— 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
1978:												
Water-----------	—	—	—	—	—	—	—	—	—	—	—	—
2014:												
Williams--------	0-6	Loam	CL, ML	A-4, A-7, A-6	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells--------	0-6	Loam	CL	A-4, A-6	0	0-5	95-100	90-100	85-95	60-90	28-37	9-16
	6-14	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	14-23	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	23-36	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	36-60	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
2015:												
Williams--------	0-6	Loam	CL, ML	A-4, A-6, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Bowbells--------	0-6	Loam	CL	A-4, A-6	0	0-5	95-100	90-100	85-95	60-90	28-37	9-16
	6-14	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	14-23	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	23-36	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
	36-60	Loam, clay loam	CL	A-6, A-7	0	0-5	95-100	90-100	80-95	60-80	20-45	10-25
2023:												
Williams--------	0-6	Loam	CL, ML	A-4, A-7, A-6	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Niobell---------	0-6	Loam	CL-ML, CL, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	6-9	Loam	CL, ML, CL-ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	9-19	Clay, clay loam, silty clay	CH, CL	A-6, A-7	0	0-1	95-100	95-100	90-100	70-80	30-60	15-35
	19-29	Silty clay, clay, clay loam	CL, CH	A-7	0	0-1	95-100	90-100	85-100	65-85	40-60	15-30
	29-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0	0-1	95-100	95-100	85-95	60-75	25-40	3-18
2024:												
Williams--------	0-6	Loam	CL, ML	A-4, A-6, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2024:(cont.)												
Niobell---------	0-6	Loam	CL, ML, CL-ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	6-9	Loam	CL-ML, CL, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	9-19	Clay, clay loam, silty clay	CH, CL	A-6, A-7	0	0-1	95-100	95-100	90-100	70-80	30-60	15-35
	19-29	Silty clay, clay, clay loam	CL, CH	A-7	0	0-1	95-100	90-100	85-100	65-85	40-60	15-30
	29-60	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0	0-1	95-100	95-100	85-95	60-75	25-40	3-18
2031:												
Williams--------	0-6	Loam	CL, ML	A-6, A-4, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
2081:												
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Williams--------	0-6	Loam	CL, ML	A-6, A-4, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
2130:												
Williams--------	0-6	Loam	CL, ML	A-4, A-6, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Parnell---------	0-15	Silty clay loam	CH, OL, CL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	15-22	Silt loam, silty clay loam	CL, CH, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	22-32	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	32-55	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	55-60	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2131:												
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Williams--------	0-6	Loam	CL, ML	A-6, A-4, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Parnell---------	0-15	Silty clay loam	CH, OL, CL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	15-22	Silt loam, silty clay loam	CH, CL, OL	A-7	0	0-1	100	100	95-100	85-100	40-55	20-35
	22-32	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	32-55	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	100	95-100	90-100	70-100	50-75	30-50
	55-60	Clay loam, silty clay loam, silty clay	CH, CL	A-7	0	0-2	95-100	90-100	80-95	70-95	50-60	30-40
2169:												
Harriet---------	0-2	Silt loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-100	70-90	25-40	5-20
	2-18	Clay loam, silty clay loam, silty clay, clay	CH, CL	A-6, A-7	0	0	100	100	90-100	70-100	35-70	20-40
	18-28	Loam, silty clay loam, clay loam	CH, CL	A-6	0	0	100	100	90-100	60-100	25-55	10-30
	28-38	Very fine sandy loam	CL-ML	A-4	0	0	100	100	85-95	50-65	25-35	10-15
	38-40	Clay loam	CL, CL-ML	A-6, A-7	0	0	100	100	90-100	70-80	40-50	20-30
	40-60	Stratified very fine sandy loam to silty clay	CL-ML, CL, CH	A-4, A-7, A-6	0	—	100	100	90-100	60-100	20-65	5-40
Regan-----------	0-9	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	100	95-100	70-95	20-40	5-20
	9-28	Silty clay loam, silt loam	CL	A-6, A-7	0	0	100	100	90-100	70-95	20-40	10-20
	28-60	Stratified sandy loam to silty clay loam	SC, CL	A-6, A-4, A-7	0	0	100	100	65-100	35-95	15-50	10-20

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2169:(cont.)												
Stirum----------	0-7	Fine sandy loam	ML, CL-ML, SC-SM, SM	A-2, A-4	0	0	100	100	60-95	30-60	15-25	NP-5
	7-15	Loam, fine sandy loam, sandy loam	ML, CL, SC, SM	A-2, A-4	0	0	100	100	60-95	30-75	15-30	NP-10
	15-26	Loam, stratified fine sand to loamy sand to fine sandy loam to silty clay loam	ML, SC, CL, SM	A-4, A-2, A-6	0	0	100	100	50-100	15-90	0-30	NP-15
	26-34	Very fine sandy loam, stratified fine sand to loamy sand to fine sandy loam to silty clay loam	CL, SM, ML, SC	A-2, A-4, A-6	0	0	100	100	50-100	15-90	0-30	NP-15
	34-44	Silt loam, stratified fine sand to loamy sand to fine sandy loam to silty clay loam	ML, CL, SC, SM	A-4, A-6, A-2	0	0	100	100	50-100	15-90	0-30	NP-15
	44-60	Loamy fine sand, stratified fine sand to loamy sand to fine sandy loam to silty clay loam	ML, SC, CL, SM	A-2, A-6, A-4	0	0	100	100	50-100	15-90	0-30	NP-15
2170:												
Divide----------	0-8	Loam	CL, CL-ML	A-4, A-6	—	0	95-100	95-100	85-95	60-85	25-40	5-20
	8-12	Loam, clay loam, gravelly loam	CL-ML, SC, CL, SC-SM	A-4, A-7, A-6	—	0-3	95-100	75-100	55-90	35-80	20-45	5-20
	12-22	Loam, clay loam, gravelly loam	CL-ML, CL, SC, SC-SM	A-4, A-6, A-7	—	0-3	95-100	75-100	55-90	35-80	20-45	5-20
	22-26	Gravelly loamy coarse sand, stratified sand to gravelly sand	GP-GM, SM, GM, SP-SM	A-1, A-3	—	0-5	25-100	15-100	10-70	5-25	0-30	NP-5
	26-60	Very gravelly coarse sand, stratified sand to gravelly sand	GP-GM, SM, GM, SP-SM	A-1, A-3	—	0-5	25-100	15-100	10-70	5-25	0-30	NP-5

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments >10 inches	Fragments 3-10 inches	Percentage passing sieve number— 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct	Pct					Pct	
2171:												
Sakakawea-------	0-6	Loam	CL, CL-ML, ML	A-4, A-6	0	0	100	95-100	80-95	55-75	25-40	5-20
	6-21	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	21-41	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	41-60	Stratified loamy sand to silty clay	CL, ML, SM, SC	A-2, A-6, A-4	0	0	100	95-100	50-100	10-85	15-40	NP-25
Farnuf----------	0-9	Loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-95	70-80	25-40	5-20
	9-23	Loam, clay loam	CL	A-6, A-7	0	0	100	100	80-95	55-85	30-50	15-25
	23-34	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	100	100	80-95	70-95	35-50	15-25
	34-60	Stratified fine sandy loam to silty clay loam	CH, CL-ML, CL	A-4, A-7, A-6	0	0	100	100	75-100	70-100	25-55	5-30
2172:												
Sakakawea-------	0-6	Loam	CL-ML, CL, ML	A-4, A-6	0	0	100	95-100	80-95	55-75	25-40	5-20
	6-21	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	21-41	Silt loam, loam	CL, CL-ML	A-4, A-6	0	0	100	95-100	85-100	65-85	20-40	5-25
	41-60	Stratified loamy sand to silty clay	ML, CL, SC, SM	A-4, A-2, A-6	0	0	100	95-100	50-100	10-85	15-40	NP-25
Farnuf----------	0-9	Loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-95	70-80	25-40	5-20
	9-23	Loam, clay loam	CL	A-6, A-7	0	0	100	100	80-95	55-85	30-50	15-25
	23-34	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	100	100	80-95	70-95	35-50	15-25
	34-60	Stratified fine sandy loam to silty clay loam	CH, CL-ML, CL	A-4, A-6, A-7	0	0	100	100	75-100	70-100	25-55	5-30
2173:												
Marias----------	0-6	Silty clay	CH, CL	A-7	0	0	100	100	95-100	90-95	40-60	20-40
	6-11	Clay, silty clay	CH, CL	A-7	0	0	100	100	90-100	75-95	40-70	25-50
	11-27	Clay, silty clay	CH, CL	A-7	0	0	100	100	90-100	75-95	40-70	25-50
	27-60	Clay			—	—	—	—	—	—	40-70	25-50
2174:												
Marias----------	0-6	Silty clay	CH, CL	A-7	0	0	100	100	95-100	90-95	40-60	20-40
	6-11	Clay, silty clay	CH, CL	A-7	0	0	100	100	90-100	75-95	40-70	25-50
	11-27	Clay, silty clay	CH, CL	A-7	0	0	100	100	90-100	75-95	40-70	25-50
	27-60	Clay			—	—	—	—	—	—	40-70	25-50
2175:												
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification Unified	Classification AASHTO	Fragments >10 inches	Fragments 3-10 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
2175:(cont.)												
Williams--------	0-6	Loam	CL, ML	A-4, A-7, A-6	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
2176:												
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Williams--------	0-6	Loam	CL, ML	A-6, A-4, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
2177:												
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Williams--------	0-6	Loam	CL, ML	A-6, A-4, A-7	0-2	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Vallers---------	0-9	Silt loam, loam	CL-ML, ML	A-4	0-1	0-5	95-100	90-100	80-90	50-80	30-40	4-10
	9-44	Clay loam, silty clay loam, loam	CL	A-6	0-1	0-5	95-100	90-100	80-95	50-80	30-40	11-20
	44-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-1	0-5	95-100	90-100	85-95	60-85	20-40	5-20
2178:												
Farnuf----------	0-9	Loam	CL, CL-ML	A-4, A-6	0	0	100	100	90-95	70-80	25-40	5-20
	9-23	Loam, clay loam	CL	A-6, A-7	0	0	100	100	80-95	55-85	30-50	15-25
	23-34	Loam, clay loam, silty clay loam	CL	A-6, A-7	0	0	100	100	80-95	70-95	35-50	15-25
	34-60	Stratified fine sandy loam to silty clay loam	CL, CH, CL-ML	A-6, A-4, A-7	0	0	100	100	75-100	70-100	25-55	5-30
Alkabo----------	0-6	Silt loam	CL, ML, CL-ML	A-4, A-6	0	0	100	100	85-100	60-90	25-45	5-25
	6-9	Silt loam, loam	CL-ML, ML	A-4	0	0	100	100	85-100	60-90	25-40	5-20
	9-17	Silt loam, silty clay loam	CH, CL	A-6, A-7	0	0	100	100	90-100	70-95	25-50	5-30
	17-45	Silt loam, silty clay loam	CH, CL	A-6, A-4, A-7	0	0	100	100	90-100	70-95	25-50	5-30
	45-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6	0	0-2	95-100	90-100	85-100	60-80	25-50	5-30

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments >10 inches	Fragments 3-10 inches	Percentage passing sieve number— 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct	Pct					Pct	
2179:												
Noonan----------	0-6	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-1	95-100	95-100	80-95	55-75	20-38	5-20
	6-9	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	9-12	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	12-20	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	20-28	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
Niobell---------	0-6	Loam	CL, CL-ML, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	6-9	Loam	CL-ML, CL, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	9-19	Clay, clay loam, silty clay	CH, CL	A-6, A-7	0	0-1	95-100	95-100	90-100	70-80	30-60	15-35
	19-29	Silty clay, clay, clay loam	CL, CH	A-7	0	0-1	95-100	90-100	85-100	65-85	40-60	15-30
	29-60	Loam, clay loam	ML, CL-ML, CL	A-4, A-6	0	0-1	95-100	95-100	85-95	60-75	25-40	3-18
2180:												
Niobell---------	0-6	Loam	CL, ML, CL-ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	6-9	Loam	CL-ML, CL, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-75	25-38	3-15
	9-19	Clay, clay loam, silty clay	CH, CL	A-6, A-7	0	0-1	95-100	95-100	90-100	70-80	30-60	15-35
	19-29	Silty clay, clay, clay loam	CL, CH	A-7	0	0-1	95-100	90-100	85-100	65-85	40-60	15-30
	29-60	Loam, clay loam	CL, ML, CL-ML	A-4, A-6	0	0-1	95-100	95-100	85-95	60-75	25-40	3-18
Noonan----------	0-6	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-1	95-100	95-100	80-95	55-75	20-38	5-20
	6-9	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	9-12	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	12-20	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	20-28	Loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
	28-60	Loam, clay loam	CL, CL-ML	A-6, A-4, A-7	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
Tonka-----------	0-13	Silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	13-19	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-2	100	95-100	90-100	70-90	20-35	5-15
	19-34	Silty clay loam, clay loam, clay	CH, CL	A-6, A-7	0-1	0-2	100	95-100	90-100	75-95	35-55	15-35
	34-50	Silty clay loam, clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
	50-60	Silty clay loam, clay loam, loam	CL, CL-ML	A-6, A-4, A-7	0-1	0-3	90-100	85-100	60-100	50-90	25-50	5-30
2181:												
Miranda---------	0-4	Loam	CL-ML, CL, ML	A-4, A-6	0	0	100	100	85-95	60-85	35-42	15-22
	4-10	Clay loam, clay, silty clay	CL, CH	A-6, A-7	0	0-5	95-100	95-100	85-95	50-80	48-60	27-35
	10-16	Clay loam, clay, silty clay	CL, CH	A-6, A-7	0	0-5	95-100	95-100	80-95	50-80	48-60	27-35
	16-30	Clay loam, loam	CL	A-6, A-7	0	0-5	95-100	95-100	70-95	60-80	40-50	20-30
	30-60	Loam, clay loam, sandy loam	CL, ML, SM	A-4, A-7, A-6	0	0-5	95-100	95-100	60-95	30-80	34-50	15-28

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2181:(cont.)												
Noonan----------	0-6	Loam, silt loam	CL, CL-ML	A-4, A-6	0-1	0-1	95-100	95-100	80-95	55-75	20-38	5-20
	6-9	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	9-12	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	12-20	Clay loam	CH, CL	A-6, A-7	0-1	0-1	95-100	95-100	85-95	65-85	25-60	10-35
	20-28	Loam, clay loam	CL, CL-ML	A-4, A-7, A-6	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
	28-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-1	0-1	90-100	85-100	75-95	60-85	25-50	5-30
2182:												
Portal----------	0-6	Fine sandy loam	ML, SM	A-2, A-4	0	0	100	100	60-85	30-55	20-35	NP-10
	6-8	Fine sand, loamy fine sand	SM	A-2	0	0	100	100	50-80	15-35	20-35	NP-10
	8-12	Sandy loam, fine sandy loam	ML, SM, SC, SC-SM	A-2, A-4, A-6	0	0	100	100	60-85	30-55	20-40	NP-15
	12-22	Sandy loam, fine sandy loam	SC, ML, SC-SM, SM	A-2, A-4, A-6	0	0	100	100	60-85	30-55	20-40	NP-15
	22-40	Sandy loam, fine sandy loam			0	0	100	100	60-85	30-55	20-40	NP-15
	40-60	Sandy loam, fine sandy loam	ML, SC, SM, SC-SM	A-2, A-4, A-6	0	0	100	100	60-85	30-55	20-40	NP-15
Lihen-----------	0-9	Fine sandy loam	ML, CL-ML, SC, SM	A-2, A-4	0	0	100	100	60-85	30-55	15-25	NP-10
	9-24	Loamy sand, loamy fine sand, sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	24-32	Sand, fine sand, loamy sand, loamy fine sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	32-60	Sand, fine sand, loamy fine sand, loamy sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
2183:												
Lihen-----------	0-9	Loamy fine sand, loamy sand, sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	9-24	Loamy sand, loamy fine sand, sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	24-32	Sand, fine sand, loamy sand, loamy fine sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	32-60	Sand, fine sand, loamy fine sand, loamy sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
Blanchard-------	0-3	Loamy fine sand	SM	A-2	0	0	100	100	50-75	15-30	0-14	NP
	3-60	Fine sand, loamy sand, loamy fine sand	SM	A-2	0	0	100	100	60-85	15-35	0-14	NP

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2184:												
Williams--------	0-6	Sandy loam	ML, SC, SM	A-2, A-4	0-2	0-5	90-100	80-100	55-100	25-55	15-30	NP-10
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-4, A-7, A-6	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
2185:												
Williams--------	0-6	Sandy loam	ML, SC, SM	A-2, A-4	0-2	0-5	90-100	80-100	55-100	25-55	15-30	NP-10
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl------------	0-5	Loam	CL	A-6	0	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-20	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
	20-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0	0-1	90-100	85-100	80-95	55-80	25-50	5-30
Lihen-----------	0-9	Fine sandy loam	CL-ML, ML, SM, SC	A-2, A-4	0	0	100	100	60-85	30-55	15-25	NP-10
	9-24	Loamy sand, loamy fine sand, sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	24-32	Sand, fine sand, loamy sand, loamy fine sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
	32-60	Sand, fine sand, loamy fine sand, loamy sand	SM	A-2	0	0	100	100	50-90	15-35	0-20	NP-5
2186:												
Lehr------------	0-6	Loam	CL, CL-ML, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-80	20-40	3-15
	6-11	Loam, clay loam, gravelly loam	SC-SM, CL, SC, CL-ML	A-4, A-6	0-2	0-5	90-100	80-100	75-95	40-75	25-40	5-15
	11-15	Loam, clay loam, gravelly loam	CL-ML, SC, CL, SC-SM	A-4, A-6	0-2	0-5	90-100	80-100	75-95	40-75	25-40	5-15
	15-22	Gravelly sandy loam, gravelly coarse sandy loam, gravelly loamy coarse sand	SM, SP-SM	A-1	0-2	0-5	65-90	50-75	30-50	5-15	0-14	NP
	22-60	Gravelly loamy sand, gravelly sand, very gravelly coarse sand	GM, SP, GP, SM	A-1	0-2	0-5	40-80	25-60	10-35	2-15	0-14	NP

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2186:(cont.)												
Wabek-----------	0-5	Loam	CL, CL-ML, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-80	20-40	3-15
	5-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam	GM, SM	A-2, A-1-b, A-4	0	0-1	50-80	50-80	30-60	20-40	0-14	NP
	9-60	Very gravelly coarse sand, sand and gravel	GM, SW, SM, SP	A-1	0	0-1	25-90	10-65	5-35	0-25	0-14	NP
2187:												
Appam-----------	0-6	Sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	6-15	Sandy loam, coarse sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	15-19	Sandy loam, coarse sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	19-60	Gravelly coarse sand, coarse sand, loamy coarse sand, very gravelly coarse sand	GM, GP, SP-SM, GP-GM	A-1, A-2, A-3	0	0	35-100	25-100	10-60	0-15	0-14	NP
Wabek-----------	0-5	Gravelly sandy loam	GP, GM, SM, SP	A-1, A-2	0	0-1	50-85	40-60	10-40	3-35	0-14	NP
	5-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam	GM, SM	A-2, A-1-b, A-4	0	0-1	50-80	50-80	30-60	20-40	0-14	NP
	9-60	Very gravelly coarse sand, sand and gravel	SM, GM, SP, SW	A-1	0	0-1	25-90	10-65	5-35	0-25	0-14	NP
2188:												
Wabek-----------	0-5	Gravelly sandy loam	GM, SP, GP, SM	A-1, A-2	0	0-1	50-85	40-60	10-40	3-35	0-14	NP
	5-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam	GM, SM	A-1-b, A-4, A-2	0	0-1	50-80	50-80	30-60	20-40	0-14	NP
	9-60	Very gravelly coarse sand, sand and gravel	SW, SP, GM, SM	A-1	0	0-1	25-90	10-65	5-35	0-25	0-14	NP

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number— 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2188:(cont.)												
Lehr------------	0-6	Loam	CL, CL-ML, ML	A-4, A-6	0	0	95-100	95-100	85-95	60-80	20-40	3-15
	6-11	Loam, clay loam, gravelly loam	SC-SM, SC, CL, CL-ML	A-4, A-6	0-2	0-5	90-100	80-100	75-95	40-75	25-40	5-15
	11-15	Loam, clay loam, gravelly loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0-2	0-5	90-100	80-100	75-95	40-75	25-40	5-15
	15-22	Gravelly sandy loam, gravelly coarse sandy loam, gravelly loamy coarse sand	SM, SP-SM	A-1	0-2	0-5	65-90	50-75	30-50	5-15	0-14	NP
	22-60	Gravelly loamy sand, gravelly sand, very gravelly coarse sand	GP, GM, SM, SP	A-1	0-2	0-5	40-80	25-60	10-35	2-15	0-14	NP
2189:												
Wabek-----------	0-5	Gravelly sandy loam	GM, GP, SP, SM	A-1, A-2	0	0-1	50-85	40-60	10-40	3-35	0-14	NP
	5-9	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam	GM, SM	A-2, A-1-b, A-4	0	0-1	50-80	50-80	30-60	20-40	0-14	NP
	9-60	Very gravelly coarse sand, sand and gravel	SM, GM, SP, SW	A-1	0	0-1	25-90	10-65	5-35	0-25	0-14	NP
Appam-----------	0-6	Sandy loam	SC-SM, SC, SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	6-15	Sandy loam, coarse sandy loam	SC, SC-SM, SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	15-19	Sandy loam, coarse sandy loam	SC, SM, SC-SM	A-2, A-4	0	0	85-100	85-100	60-80	30-40	0-25	NP-10
	19-60	Gravelly coarse sand, coarse sand, loamy coarse sand, very gravelly coarse sand	GM, SP-SM, GP, GP-GM	A-2, A-1, A-3	0	0	35-100	25-100	10-60	0-15	0-14	NP
2190:												
Williams--------	0-6	Sandy loam	SC, ML, SM	A-2, A-4	0-2	0-5	90-100	80-100	55-100	25-55	15-30	NP-10
	6-10	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	10-15	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	15-24	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	24-36	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	36-60	Clay loam, loam	CL	A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	30-50	10-30

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments: >10 inches	Fragments: 3-10 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct	Pct					Pct	
2191:												
Towner----------	0-9	Loamy fine sand	SC-SM, SM	A-2	0	0	100	100	50-80	15-35	15-25	NP-5
	9-20	Loamy fine sand	SC-SM, SM	A-2	0	0	100	100	50-80	15-35	15-25	NP-5
	20-29	Loamy sand, loamy fine sand, fine sand	SC-SM, SW-SM, SM	A-2, A-3	0	0	100	95-100	50-100	5-35	15-25	NP-5
	29-36	Loam, silt loam, silty clay loam	CL, CL-ML	A-4, A-6, A-7	0	0-5	95-100	90-100	85-100	55-100	25-50	5-30
	36-60	Loam, silt loam, silty clay loam	CL, CL-ML	A-4, A-7, A-6	0	0-5	95-100	90-100	85-100	55-100	25-50	5-30
Kratka----------	0-6	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	6-11	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	11-14	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	14-18	Loamy sand, sand, loamy fine sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	—	NP
	18-25	Fine sand, loamy sand, loamy fine sand, sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	—	NP
	25-31	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
	31-39	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
	39-60	Loam, clay loam, sandy loam	CL-ML, SC, CL, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
2192:												
Kratka----------	0-6	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	6-11	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	11-14	Fine sandy loam	SC-SM, SM	A-4	0	0	95-100	90-100	50-80	36-50	15-25	2-6
	14-18	Loamy sand, sand, loamy fine sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	—	NP
	18-25	Loamy sand, fine sand, sand, loamy fine sand	SP-SM	A-2, A-3	0	0	95-100	90-100	50-80	5-10	—	NP
	25-31	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
	31-39	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
	39-60	Loam, clay loam, sandy loam	CL, CL-ML, SC-SM, SC	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25

Table 19.-Engineering Index Properties--Continued

Map symbol and soil name	Depth	USDA texture	Classification		Fragments		Percentage passing sieve number—				Liquid limit	Plas- ticity index
			Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
	In				Pct	Pct					Pct	
2192:(cont.)												
Wyndmere--------	0-8	Fine sandy loam	CL-ML, SM, ML, SC-SM	A-2, A-4	0	0	100	100	60-80	30-55	15-25	NP-10
	8-15	Fine sandy loam	ML, CL-ML, SC-SM, SM	A-2, A-4	0	0	100	100	60-80	30-55	15-25	NP-10
	15-26	Sandy loam, fine sandy loam	ML, SM, SC, SC-SM	A-2, A-4	0	0	100	100	60-90	30-55	15-25	NP-10
	26-60	Loam, clay loam, sandy loam	CL-ML, CL, SC, SC-SM	A-4, A-6	0	0	95-100	90-100	70-90	40-75	15-40	5-25
2193:												
Dumps, mine-----	0-4	Clay loam	CL, ML	A-4, A-7, A-6	0-1	0-10	95-100	95-100	85-95	60-90	25-45	3-20
	4-60	Loam, clay loam	CL	A-6, A-7	0-10	0-10	95-100	95-100	80-100	60-80	25-50	5-30
Ustorthents-----	0-4	Loam	CL, ML	A-4, A-6, A-7	—	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	4-60	Loam, clay loam	CL	A-4, A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	25-50	5-30
2194:												
Haplustolls-----	0-16	Loam	CL, ML	A-4, A-6, A-7	—	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	16-60	Loam, clay loam	CL	A-4, A-7, A-6	0-2	0-5	95-100	95-100	80-100	60-80	25-50	5-30
Ustorthents-----	0-4	Loam	CL, ML	A-4, A-7, A-6	—	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	4-60	Loam, clay loam	CL	A-4, A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	25-50	5-30
2195:												
Ustorthents-----	0-4	Loam	CL, ML	A-4, A-7, A-6	—	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	4-60	Loam, clay loam	CL	A-4, A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	25-50	5-30
Haplustolls-----	0-16	Loam	CL, ML	A-4, A-7, A-6	—	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	16-60	Loam, clay loam	CL	A-4, A-6, A-7	0-2	0-5	95-100	95-100	80-100	60-80	25-50	5-30
2227:												
Swenoda---------	0-9	Loam, sandy loam, fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	9-13	Loam, sandy loam, fine sandy loam	SC-SM, SM	A-2, A-4	0	0	100	95-100	70-100	30-50	20-30	5-10
	13-19	Fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	19-29	Fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	29-33	Fine sandy loam, sandy loam, loamy fine sand	CL-ML, SC-SM	A-2, A-4	0	0	100	95-100	60-100	30-60	20-30	5-10
	33-39	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20
	39-60	Silt loam, silty clay loam, loam	CL, CL-ML	A-6, A-7	0	0-5	90-100	90-100	75-100	50-95	30-45	10-20

Table 20.—Physical Properties of the Soils

(The symbol < means less than; > means greater than. Entries under "Erosion factors—T" apply to the entire profile. Entries under "Wind erodibility group" and "Wind erodibility index" apply only to the surface layer. Dashes (—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Erosion factors Kf	Erosion factors T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
110:												
Barnes----------------	0-7	18-27	1.10-1.40	0.6-2	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	7-19	18-35	1.20-1.60	0.6-2	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	19-37	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	1.0-2.0	.37	.37			
	37-60	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
111:												
Barnes----------------	0-7	18-27	1.10-1.40	0.6-2	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	7-19	18-35	1.20-1.60	0.6-2	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	19-37	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	1.0-2.0	.37	.37			
	37-60	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
120:												
Barnes----------------	0-7	18-27	1.10-1.50	0.6-2	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	7-19	18-35	1.20-1.60	0.6-2	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	19-37	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-1.0	.37	.37			
	37-60	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-0.5	.37	.37			
Buse------------------	0-8	18-27	1.20-1.35	0.2-2	0.20-0.24	Low	1.0-3.0	.28	.28	5	4L	86
	8-40	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-1.0	.37	.37			
	40-60	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-1.0	.37	.37			
470:												
Cresbard--------------	0-9	20-26	1.15-1.30	0.6-2	0.17-0.20	Moderate	2.0-5.0	.32	.32	5	6	48
	9-14	20-35	1.20-1.30	0.2-2	0.17-0.20	Moderate	1.0-3.0	.32	.32			
	14-34	35-50	1.20-1.35	0.06-0.2	0.11-0.14	High	0.5-2.0	.32	.32			
	34-55	28-40	1.20-1.40	0.2-2	0.16-0.19	High	0.0-0.5	.32	.32			
	55-60	22-35	1.40-1.60	0.2-2	0.16-0.19	Moderate	0.0-0.5	.32	.32			
Barnes----------------	0-7	18-27	1.10-1.50	0.6-2	0.20-0.22	Low	3.0-6.0	.24	.24	5	6	48
	7-19	18-35	1.20-1.60	0.6-2	0.15-0.19	Moderate	2.0-5.0	.28	.28			
	19-37	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-1.0	.37	.37			
	37-60	18-35	1.30-1.60	0.2-2	0.14-0.19	Moderate	0.0-0.5	.37	.37			
674:												
Farnuf----------------	0-9	20-27	1.20-1.40	0.6-2	0.18-0.20	Low	2.0-4.0	.28	.28	5	6	48
	9-23	25-35	1.25-1.35	0.2-2	0.15-0.20	Moderate	1.0-2.0	.28	.28			
	23-34	25-35	1.20-1.45	0.2-2	0.15-0.20	Moderate	0.5-1.0	.32	.32			
	34-60	15-35	1.25-1.45	0.2-2	0.15-0.20	Moderate	0.0-0.5	.32	.32			
676:												
Farnuf----------------	0-9	20-27	1.20-1.40	0.6-2	0.18-0.20	Low	2.0-4.0	.28	.28	5	6	48
	9-23	25-35	1.25-1.35	0.2-2	0.15-0.20	Moderate	1.0-2.0	.28	.28			
	23-34	25-35	1.20-1.45	0.2-2	0.15-0.20	Moderate	0.5-1.0	.32	.32			
	34-60	15-35	1.25-1.45	0.2-2	0.15-0.20	Moderate	0.0-0.5	.32	.32			
Sakakawea-------------	0-6	12-26	1.10-1.30	0.6-2	0.20-0.22	Moderate	2.0-5.0	.28	.28	5	4L	86
	6-21	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	1.0-4.0	.28	.28			
	21-41	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	0.5-1.5	.28	.28			
	41-60	10-45	1.40-1.60	0.2-2	0.08-0.20	Moderate	0.0-0.5	.28	.28			
882:												
Hamerly---------------	0-8	18-27	1.20-1.60	0.6-2	0.18-0.24	Moderate	4.0-7.0	.24	.24	5	4L	86
	8-35	18-35	1.30-1.60	0.6-2	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	35-60	18-35	1.30-1.60	0.2-0.6	0.14-0.19	Moderate	0.0-0.5	.37	.37			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
882:(cont.)												
Tonka	0-13	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	5.0-10	.37	.37	5	6	48
	13-19	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	2.0-6.0	.37	.37			
	19-34	35-45	1.40-1.65	0.06-0.2	0.14-0.19	High	1.0-4.0	.43	.43			
	34-50	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
	50-60	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
975:												
Heil	0-3	18-27	1.20-1.40	0.6-2	0.15-0.24	Moderate	3.0-6.0	.37	.37	2	6	48
	3-24	45-60	1.20-1.55	0.001-0.06	0.13-0.19	High	1.0-4.0	.37	.37			
	24-38	27-50	1.30-1.65	0.001-0.2	0.13-0.19	High	1.0-2.0	—	—			
	38-52	27-50	1.30-1.65	0.001-0.2	0.13-0.19	High	0.5-1.0	—	—			
	52-60	20-50	1.30-1.60	0.001-2	0.13-0.19	High	0.5-1.0	.32	.32			
1267:												
Marysland	0-9	18-27	1.20-1.30	0.6-2	0.17-0.24	Moderate	5.0-8.0	.28	.28	4	4L	86
	9-12	18-27	1.20-1.30	0.6-2	0.17-0.24	Moderate	5.0-8.0	.28	.28			
	12-15	18-27	1.20-1.35	0.2-2	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	15-20	18-27	1.20-1.35	0.2-2	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	20-27	18-27	1.20-1.35	0.2-2	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	27-40	1-5	1.45-1.65	6-20	0.02-0.07	Low	0.0-0.5	.10	.10			
	40-60	1-5	1.45-1.65	6-20	0.02-0.07	Low	0.0-0.5	.10	.10			
1427:												
Parnell	0-15	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	15-22	18-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.28	.28			
	22-32	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.37	.37			
	32-55	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	55-60	35-45	1.30-1.50	0.06-0.2	0.11-0.19	High	0.5-1.0	.37	.37			
1439:												
Parshall	0-12	5-20	1.10-1.40	2-6	0.16-0.18	Low	1.0-4.0	.20	.20	5	3	86
	12-29	5-18	1.20-1.50	2-6	0.13-0.16	Low	1.0-3.0	.20	.20			
	29-48	5-18	1.20-1.60	2-6	0.13-0.15	Low	0.5-1.0	.24	.24			
	48-60	5-15	1.40-1.70	6-20	0.11-0.13	Low	0.0-1.0	.17	.17			
1466:												
Pits, sand and gravel	0-6	5-15	1.20-1.60	6-60	0.01-0.04	Low	0.5-1.0	.10	.20	5	8	0
	6-60	0-15	1.20-1.60	6-60	0.01-0.04	Low	0.0-0.5	.10	.17			
1709:												
Southam	0-16	15-26	1.10-1.40	0.2-2	0.22-0.24	Low	5.0-15	.37	.37	5	4L	86
	16-40	35-50	1.20-1.50	0.06-0.2	0.14-0.20	High	1.0-5.0	.28	.28			
	40-60	18-50	1.20-1.50	0.06-0.6	0.13-0.17	High	0.5-2.0	.28	.28			
1739:												
Straw	0-5	18-27	1.10-1.30	0.6-2	0.16-0.18	Low	3.0-5.0	.32	.32	5	6	48
	5-23	18-27	1.10-1.30	0.6-2	0.16-0.18	Low	1.0-4.0	.32	.32			
	23-30	18-34	1.15-1.40	0.6-2	0.15-0.19	Moderate	1.0-3.0	.32	.32			
	30-36	18-34	1.20-1.40	0.6-2	0.13-0.19	Moderate	0.5-2.0	.32	.32			
	36-40	18-34	1.10-1.30	0.6-2	0.15-0.19	Moderate	1.0-3.0	.32	.32			
	40-66	18-34	1.20-1.40	0.6-2	0.13-0.19	Moderate	0.5-1.0	.32	.32			
1835:												
Tonka	0-13	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	5.0-10	.37	.37	5	6	48
	13-19	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	2.0-6.0	.37	.37			
	19-34	35-45	1.40-1.65	0.06-0.2	0.14-0.19	High	1.0-3.0	.43	.43			
	34-50	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
	50-60	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
1871:												
Vallers, saline-------	0-9	18-27	1.20-1.35	0.6-2	0.13-0.16	Low	5.0-8.0	.28	.28	5	4L	86
	9-44	18-35	1.40-1.55	0.2-0.6	0.10-0.13	Moderate	1.0-3.0	.28	.28			
	44-60	18-35	1.45-1.60	0.2-0.6	0.10-0.13	Moderate	0.0-1.0	.28	.28			
1883:												
Vallers---------------	0-9	18-27	1.20-1.35	0.6-2	0.22-0.24	Low	5.0-8.0	.28	.28	5	4L	86
	9-44	18-35	1.40-1.55	0.2-0.6	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	44-60	18-35	1.45-1.60	0.2-0.6	0.17-0.19	Moderate	0.0-1.0	.28	.28			
Parnell---------------	0-15	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	15-22	18-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.28	.28			
	22-32	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.37	.37			
	32-55	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	55-60	35-45	1.30-1.50	0.06-0.2	0.11-0.19	High	0.5-1.0	.37	.37			
1978:												
Water-----------------	—	—	—	—	—	—	—	—	—	-	—	—
2014:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Bowbells--------------	0-6	18-27	1.10-1.40	0.6-2	0.17-0.19	Low	2.0-6.0	.24	.24	5	6	48
	6-14	20-35	1.20-1.50	0.6-2	0.16-0.22	Moderate	2.0-4.0	.28	.28			
	14-23	20-35	1.20-1.50	0.6-2	0.16-0.22	Moderate	2.0-4.0	.28	.28			
	23-36	20-35	1.30-1.60	0.2-0.6	0.14-0.18	Moderate	1.0-2.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.14-0.18	Moderate	0.0-1.0	.37	.37			
2015:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Bowbells--------------	0-6	18-27	1.10-1.40	0.6-2	0.17-0.19	Low	2.0-6.0	.24	.24	5	6	48
	6-14	20-35	1.20-1.50	0.6-2	0.16-0.22	Moderate	2.0-4.0	.28	.28			
	14-23	20-35	1.20-1.50	0.6-2	0.16-0.22	Moderate	2.0-4.0	.28	.28			
	23-36	20-35	1.30-1.60	0.2-0.6	0.14-0.18	Moderate	1.0-2.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.14-0.18	Moderate	0.0-1.0	.37	.37			
2023:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Niobell---------------	0-6	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-6.0	.32	.32	5	6	48
	6-9	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-5.0	.32	.32			
	9-19	35-50	1.20-1.50	0.06-0.6	0.11-0.14	High	1.0-3.0	.32	.32			
	19-29	35-50	1.20-1.60	0.06-0.6	0.11-0.15	High	1.0-2.5	.37	.37			
	29-60	18-30	1.20-1.60	0.2-0.6	0.15-0.19	Moderate	0.5-1.0	.37	.37			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2024:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Niobell---------------	0-6	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-6.0	.32	.32	5	6	48
	6-9	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-5.0	.32	.32			
	9-19	35-50	1.20-1.50	0.06-0.6	0.11-0.14	High	1.0-3.0	.32	.32			
	19-29	35-50	1.20-1.60	0.06-0.6	0.11-0.15	High	1.0-1.5	.37	.37			
	29-60	18-30	1.20-1.60	0.2-0.6	0.15-0.19	Moderate	0.5-1.0	.37	.37			
2031:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
2081:												
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
2130:												
Williams--------------	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Parnell---------------	0-15	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	15-22	18-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.28	.28			
	22-32	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.37	.37			
	32-55	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	55-60	35-45	1.30-1.50	0.06-0.2	0.11-0.19	High	0.5-1.0	.37	.37			
2131:												
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2131:(cont.)												
Williams	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Parnell	0-15	27-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.37	.37	5	7	38
	15-22	18-40	1.10-1.30	0.2-0.6	0.18-0.22	Moderate	6.0-10	.28	.28			
	22-32	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.37	.37			
	32-55	27-60	1.20-1.40	0.06-0.2	0.13-0.19	High	3.0-5.0	.28	.28			
	55-60	35-45	1.30-1.50	0.06-0.2	0.11-0.19	High	0.5-1.0	.37	.37			
2169:												
Harriet	0-2	12-25	1.10-1.40	0.6-2	0.20-0.24	Low	3.0-6.0	.37	.37	2	6	48
	2-18	35-50	1.20-1.60	0.001-0.06	0.10-0.15	High	1.0-3.0	.37	.37			
	18-28	18-40	1.20-1.60	0.6-2	0.10-0.15	Moderate	0.5-1.0	.37	.37			
	28-38	10-18	1.40-1.60	0.6-2	0.09-0.15	Low	0.5-1.0	.37	.37			
	38-40	27-35	1.35-1.55	0.6-2	0.09-0.12	Moderate	0.0-1.0	—	—			
	40-60	18-45	1.20-1.60	0.06-0.2	0.09-0.12	Moderate	0.0-0.5	—	—			
Regan	0-9	18-27	1.10-1.40	0.2-2	0.12-0.16	Low	2.0-6.0	.32	.32	5	4L	86
	9-28	18-35	1.20-1.40	0.2-2	0.12-0.16	Moderate	1.0-3.0	.43	.43			
	28-60	18-35	1.20-1.50	0.2-2	0.12-0.16	Moderate	0.5-1.0	.32	.32			
Stirum	0-7	10-20	1.40-1.50	2-6	0.10-0.13	Low	3.0-5.0	.24	.24	2	3	86
	7-15	10-20	1.40-1.60	0.001-0.2	0.12-0.18	Low	1.0-3.0	.32	.32			
	15-26	10-27	1.40-1.50	0.6-20	0.06-0.18	Low	0.0-2.0	.17	.17			
	26-34	5-20	1.40-1.50	0.6-20	0.06-0.18	Low	0.0-2.0	.17	.17			
	34-44	5-27	1.40-1.50	0.6-20	0.06-0.18	Low	0.0-1.0	.17	.17			
	44-60	5-20	1.40-1.50	0.6-20	0.06-0.18	Low	0.0-1.0	.17	.17			
2170:												
Divide	0-8	18-27	1.10-1.40	0.6-2	0.18-0.22	Low	2.0-8.0	.28	.28	4	4L	86
	8-12	18-30	1.20-1.50	0.6-2	0.16-0.19	Low	1.0-4.0	.28	.32			
	12-22	18-30	1.20-1.50	0.6-2	0.16-0.19	Low	0.0-2.0	.28	.32			
	22-26	0-10	1.30-1.70	6-60	0.03-0.07	Low	0.0-1.0	.10	.24			
	26-60	0-10	1.30-1.70	6-60	0.03-0.07	Low	0.0-1.0	.10	.24			
2171:												
Sakakawea	0-6	12-26	1.10-1.30	0.6-2	0.20-0.22	Moderate	2.0-5.0	.28	.28	5	4L	86
	6-21	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	1.0-4.0	.28	.28			
	21-41	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	0.5-1.5	.28	.28			
	41-60	10-45	1.40-1.60	0.2-2	0.08-0.20	Moderate	0.0-0.5	.28	.28			
Farnuf	0-9	20-27	1.20-1.40	0.6-2	0.18-0.20	Low	2.0-4.0	.28	.28	5	6	48
	9-23	25-35	1.25-1.35	0.2-2	0.15-0.20	Moderate	1.0-2.0	.28	.28			
	23-34	25-35	1.20-1.45	0.2-2	0.15-0.20	Moderate	0.5-1.0	.32	.32			
	34-60	15-35	1.25-1.45	0.2-2	0.15-0.20	Moderate	0.0-0.5	.32	.32			
2172:												
Sakakawea	0-6	12-26	1.10-1.30	0.6-2	0.20-0.22	Moderate	2.0-5.0	.28	.28	5	4L	86
	6-21	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	1.0-4.0	.28	.28			
	21-41	12-26	1.20-1.50	0.6-2	0.16-0.22	Moderate	0.5-1.5	.28	.28			
	41-60	10-45	1.40-1.60	0.2-2	0.08-0.20	Moderate	0.0-0.5	.28	.28			
Farnuf	0-9	20-27	1.20-1.40	0.6-2	0.18-0.20	Low	2.0-4.0	.28	.28	5	6	48
	9-23	25-35	1.25-1.35	0.2-2	0.15-0.20	Moderate	1.0-2.0	.28	.28			
	23-34	25-35	1.20-1.45	0.2-2	0.15-0.20	Moderate	0.5-1.0	.32	.32			
	34-60	15-35	1.25-1.45	0.2-2	0.15-0.20	Moderate	0.0-0.5	.32	.32			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2173:												
Marias	0-6	40-60	1.25-1.45	0.06-0.2	0.15-0.18	High	1.0-4.0	.37	.37	5	4	86
	6-11	40-60	1.30-1.50	0.01-0.06	0.14-0.17	High	1.0-3.0	.37	.37			
	11-27	40-60	1.30-1.55	0.01-0.06	0.13-0.16	High	0.5-2.5	.37	.37			
	27-60	40-60	1.30-1.55	0.01-0.06	0.13-0.16	High	0.5-1.5	.37	.37			
2174:												
Marias	0-6	40-60	1.25-1.45	0.06-0.2	0.15-0.18	High	1.0-4.0	.37	.37	5	4	86
	6-11	40-60	1.30-1.50	0.01-0.06	0.14-0.17	High	1.0-3.0	.37	.37			
	11-27	40-60	1.30-1.55	0.01-0.06	0.13-0.16	High	0.5-2.5	.37	.37			
	27-60	40-60	1.30-1.55	0.01-0.06	0.13-0.16	High	0.5-1.5	.37	.37			
2175:												
Zahl	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Williams	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
2176:												
Zahl	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Williams	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
2177:												
Zahl	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Williams	0-6	15-27	1.10-1.40	0.6-2	0.18-0.20	Low	2.0-6.0	.28	.28	5	6	48
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Vallers	0-9	18-27	1.20-1.35	0.6-2	0.22-0.24	Low	5.0-8.0	.28	.28	5	4L	86
	9-44	18-35	1.40-1.55	0.2-0.6	0.15-0.19	Moderate	1.0-3.0	.28	.28			
	44-60	18-35	1.45-1.60	0.2-0.6	0.17-0.19	Moderate	0.0-1.0	.28	.28			
2178:												
Farnuf	0-9	20-27	1.20-1.40	0.6-2	0.18-0.20	Low	2.0-4.0	.28	.28	5	6	48
	9-23	25-35	1.25-1.35	0.2-2	0.15-0.20	Moderate	1.0-2.0	.28	.28			
	23-34	25-35	1.20-1.45	0.2-2	0.15-0.20	Moderate	0.5-1.0	.32	.32			
	34-60	15-35	1.25-1.45	0.2-2	0.15-0.20	Moderate	0.0-0.5	.32	.32			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2178:(cont.)												
Alkabo	0-6	18-27	1.10-1.30	0.6-2	0.22-0.24	Moderate	2.0-6.0	.32	.32	5	6	48
	6-9	10-27	1.10-1.30	0.6-2	0.22-0.24	Moderate	1.0-3.0	.32	.32			
	9-17	20-35	1.20-1.50	0.2-0.6	0.20-0.22	Moderate	1.0-2.5	.43	.43			
	17-45	20-35	1.20-1.50	0.2-2	0.18-0.20	Moderate	0.5-1.0	.43	.43			
	45-60	20-35	1.20-1.50	0.2-0.6	0.14-0.16	Moderate	0.0-0.5	.37	.37			
2179:												
Noonan	0-6	18-27	1.10-1.40	0.6-2	0.20-0.22	Low	2.0-5.0	.32	.32	2	6	48
	6-9	27-35	1.20-1.50	0.06-0.6	0.17-0.19	High	1.0-4.0	.32	.32			
	9-12	27-35	1.20-1.50	0.01-0.2	0.14-0.16	High	1.0-3.0	.32	.32			
	12-20	27-35	1.20-1.50	0.01-0.2	0.12-0.16	High	1.0-2.5	.32	.32			
	20-28	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.5	.37	.37			
	28-60	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.0	.37	.37			
Niobell	0-6	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-6.0	.32	.32	5	6	48
	6-9	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-5.0	.32	.32			
	9-19	35-50	1.20-1.50	0.06-0.6	0.11-0.14	High	1.0-3.0	.32	.32			
	19-29	35-50	1.20-1.60	0.06-0.6	0.11-0.15	High	1.0-1.5	.37	.37			
	29-60	18-30	1.20-1.60	0.2-0.6	0.15-0.19	Moderate	0.5-1.0	.37	.37			
2180:												
Niobell	0-6	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-6.0	.32	.32	5	6	48
	6-9	10-27	1.10-1.30	0.6-2	0.18-0.20	Low	2.0-5.0	.32	.32			
	9-19	35-50	1.20-1.50	0.06-0.6	0.11-0.14	High	1.0-3.0	.32	.32			
	19-29	35-50	1.20-1.60	0.06-0.6	0.11-0.15	High	1.0-1.5	.37	.37			
	29-60	18-30	1.20-1.60	0.2-0.6	0.15-0.19	Moderate	0.5-1.0	.37	.37			
Noonan	0-6	18-27	1.10-1.40	0.6-2	0.20-0.22	Low	2.0-5.0	.32	.32	2	6	48
	6-9	27-35	1.20-1.50	0.06-0.6	0.17-0.19	High	1.0-4.0	.32	.32			
	9-12	27-35	1.20-1.50	0.01-0.2	0.14-0.16	High	1.0-3.0	.32	.32			
	12-20	27-35	1.20-1.50	0.01-0.2	0.12-0.16	High	1.0-2.5	.32	.32			
	20-28	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.5	.37	.37			
	28-60	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.0	.37	.37			
Tonka	0-13	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	5.0-10	.37	.37	5	6	48
	13-19	18-27	1.00-1.50	0.6-2	0.18-0.23	Low	2.0-6.0	.37	.37			
	19-34	35-45	1.40-1.65	0.06-0.2	0.14-0.19	High	1.0-4.0	.43	.43			
	34-50	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
	50-60	18-39	1.40-1.70	0.06-0.2	0.14-0.19	Moderate	0.5-1.0	.37	.37			
2181:												
Miranda	0-4	18-26	1.15-1.30	0.6-2	0.18-0.20	Low	1.5-3.0	.32	.32	2	6	48
	4-10	32-45	1.20-1.40	0.01-0.06	0.17-0.19	High	1.0-3.0	.32	.32			
	10-16	32-45	1.25-1.45	0.01-0.06	0.12-0.14	High	0.5-1.5	.32	.32			
	16-30	25-35	1.25-1.50	0.06-0.6	0.12-0.14	Moderate	0.5-1.5	.32	.32			
	30-60	18-35	1.40-1.60	0.2-0.6	0.13-0.17	Moderate	0.0-1.0	.32	.32			
Noonan	0-6	18-27	1.10-1.40	0.6-2	0.20-0.22	Low	2.0-5.0	.32	.32	2	6	48
	6-9	27-35	1.20-1.50	0.06-0.6	0.17-0.19	High	1.0-4.0	.32	.32			
	9-12	27-35	1.20-1.50	0.01-0.2	0.14-0.16	High	1.0-3.0	.32	.32			
	12-20	27-35	1.20-1.50	0.01-0.2	0.12-0.16	High	1.0-2.5	.32	.32			
	20-28	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.5	.37	.37			
	28-60	20-30	1.20-1.60	0.06-0.6	0.13-0.15	Moderate	0.5-1.0	.37	.37			
2182:												
Portal	0-6	10-18	1.20-1.50	2-6	0.15-0.18	Low	1.0-3.0	.20	.20	2	3	86
	6-8	5-12	1.20-1.50	0.6-2	0.06-0.12	Low	1.0-2.5	.17	.17			
	8-12	10-18	1.30-1.70	0.06-0.6	0.10-0.15	Low	1.0-2.0	.24	.24			
	12-22	10-18	1.30-1.60	0.06-0.6	0.10-0.15	Low	0.5-1.5	.24	.24			
	22-40	10-18	1.30-1.70	0.6-6	0.08-0.12	Low	0.0-1.0	.24	.24			
	40-60	10-18	1.30-1.70	0.6-6	0.06-0.10	Low	0.0-0.5	.24	.24			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodi-bility group	Wind erodi-bility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2182:(cont.)												
Lihen-----------------	0-9	5-15	1.10-1.40	2-6	0.16-0.18	Low	1.0-4.0	.20	.20	5	2	134
	9-24	3-10	1.25-1.60	6-20	0.06-0.18	Low	1.0-3.0	.17	.17			
	24-32	3-10	1.30-1.60	6-20	0.06-0.12	Low	1.0-2.0	.17	.17			
	32-60	3-10	1.40-1.60	6-20	0.05-0.12	Low	0.0-0.5	.17	.17			
2183:												
Lihen-----------------	0-9	0-10	1.25-1.60	6-20	0.06-0.18	Low	1.0-3.0	.17	.17	5	2	134
	9-24	3-10	1.25-1.60	6-20	0.06-0.18	Low	1.0-3.0	.17	.17			
	24-32	3-10	1.30-1.60	6-20	0.06-0.12	Low	1.0-2.0	.17	.17			
	32-60	3-10	1.40-1.60	6-20	0.05-0.12	Low	0.0-0.5	.17	.17			
Blanchard-------------	0-3	2-5	1.45-1.65	6-20	0.07-0.08	Low	0.5-1.0	.17	.17	5	2	134
	3-60	0-5	1.50-1.70	6-20	0.06-0.07	Low	0.0-0.5	.17	.17			
2184:												
Williams--------------	0-6	5-20	1.10-1.40	2-6	0.15-0.18	Low	2.0-7.0	.20	.20	5	3	86
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
2185:												
Williams--------------	0-6	5-20	1.10-1.40	2-6	0.15-0.18	Low	2.0-7.0	.20	.20	5	3	86
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
Zahl------------------	0-5	18-27	1.10-1.40	0.6-2	0.17-0.22	Moderate	1.0-4.0	.28	.28	5	4L	86
	5-20	20-30	1.20-1.60	0.6-2	0.15-0.19	Moderate	0.0-2.0	.32	.32			
	20-60	20-30	1.30-1.60	0.2-0.6	0.15-0.19	Moderate	0.0-0.5	.37	.37			
Lihen-----------------	0-9	5-15	1.10-1.40	2-6	0.16-0.18	Low	1.0-4.0	.20	.20	5	3	86
	9-24	3-10	1.25-1.60	6-20	0.06-0.18	Low	1.0-3.0	.17	.17			
	24-32	3-10	1.30-1.60	6-20	0.06-0.12	Low	1.0-2.0	.17	.17			
	32-60	3-10	1.40-1.60	6-20	0.05-0.12	Low	0.0-0.5	.17	.17			
2186:												
Lehr------------------	0-6	10-27	1.10-1.40	0.6-6	0.15-0.19	Low	1.0-3.0	.28	.28	3	5	56
	6-11	18-30	1.20-1.50	0.6-6	0.17-0.20	Moderate	1.0-2.0	.20	.28			
	11-15	18-30	1.20-1.50	0.6-6	0.17-0.20	Moderate	1.0-2.0	.20	.28			
	15-22	0-10	1.40-1.70	6-60	0.09-0.11	Low	0.0-1.0	.10	.17			
	22-60	0-10	1.40-1.70	6-60	0.02-0.04	Low	0.0-1.0	.10	.17			
Wabek-----------------	0-5	10-27	1.10-1.40	0.6-6	0.15-0.19	Low	1.0-3.0	.28	.28	2	3	86
	5-9	5-15	1.20-1.60	2-20	0.11-0.15	Low	0.0-1.0	.10	.17			
	9-60	0-10	1.30-1.70	20-61	0.02-0.04	Low	0.0-0.5	.10	.10			
2187:												
Appam-----------------	0-6	6-18	1.20-1.50	2-6	0.13-0.15	Low	1.0-4.0	.20	.20	3	3	86
	6-15	6-18	1.20-1.50	2-6	0.13-0.15	Low	1.0-3.0	.20	.20			
	15-19	6-18	1.20-1.50	2-6	0.12-0.14	Low	0.0-0.5	.20	.20			
	19-60	0-10	1.40-1.60	6-20	0.02-0.10	Low	0.0-0.5	.15	.17			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2187:(cont.)												
Wabek-----------------	0-5	0-18	1.30-1.70	20-20	0.02-0.04	Low	1.0-2.0	.10	.15	2	3	86
	5-9	5-15	1.20-1.60	2-20	0.11-0.15	Low	0.0-1.0	.10	.17			
	9-60	0-10	1.30-1.70	20-61	0.02-0.04	Low	0.0-0.5	.10	.10			
2188:												
Wabek-----------------	0-5	0-18	1.30-1.70	20-20	0.02-0.04	Low	1.0-2.0	.10	.15	2	3	86
	5-9	5-15	1.20-1.60	2-20	0.11-0.15	Low	0.0-1.0	.10	.17			
	9-60	0-10	1.30-1.70	20-61	0.02-0.04	Low	0.0-0.5	.10	.10			
Lehr------------------	0-6	10-27	1.10-1.40	0.6-6	0.15-0.19	Low	1.0-3.0	.28	.28	3	5	56
	6-11	18-30	1.20-1.50	0.6-6	0.17-0.20	Moderate	1.0-2.0	.20	.28			
	11-15	18-30	1.20-1.50	0.6-6	0.17-0.20	Moderate	1.0-2.0	.20	.28			
	15-22	0-10	1.40-1.70	6-60	0.09-0.11	Low	0.0-1.0	.10	.17			
	22-60	0-10	1.40-1.70	6-60	0.02-0.04	Low	0.0-1.0	.10	.17			
2189:												
Wabek-----------------	0-5	0-18	1.30-1.70	20-20	0.02-0.04	Low	1.0-2.0	.10	.15	2	3	86
	5-9	5-15	1.20-1.60	2-20	0.11-0.15	Low	0.0-1.0	.10	.17			
	9-60	0-10	1.30-1.70	20-61	0.02-0.04	Low	0.0-0.5	.10	.10			
Appam-----------------	0-6	6-18	1.20-1.50	2-6	0.13-0.15	Low	1.0-4.0	.20	.20	3	3	86
	6-15	6-18	1.20-1.50	2-6	0.13-0.15	Low	1.0-3.0	.20	.20			
	15-19	6-18	1.20-1.50	2-6	0.12-0.14	Low	0.0-0.5	.20	.20			
	19-60	0-10	1.40-1.60	6-20	0.02-0.10	Low	0.0-0.5	.15	.17			
2190:												
Williams--------------	0-6	5-20	1.10-1.40	2-6	0.15-0.18	Low	2.0-7.0	.20	.20	5	3	86
	6-10	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-4.0	.28	.28			
	10-15	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-3.0	.28	.28			
	15-24	24-35	1.20-1.60	0.6-2	0.16-0.20	Moderate	1.0-2.0	.28	.28			
	24-36	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
	36-60	20-35	1.30-1.60	0.2-0.6	0.15-0.18	Moderate	0.0-1.0	.37	.37			
2191:												
Towner----------------	0-9	2-10	1.20-1.40	6-20	0.08-0.12	Low	1.0-3.0	.17	.17	5	2	134
	9-20	2-10	1.20-1.40	6-20	0.08-0.12	Low	1.0-2.0	.17	.17			
	20-29	2-10	1.20-1.40	6-20	0.06-0.13	Low	0.5-1.0	.17	.17			
	29-36	18-40	1.30-1.60	0.2-2	0.14-0.22	Moderate	0.0-0.5	.43	.43			
	36-60	18-40	1.30-1.60	0.2-2	0.14-0.22	Moderate	0.0-0.5	.43	.43			
Kratka----------------	0-6	5-15	1.20-1.50	2-6	0.13-0.18	Low	2.0-5.0	.17	.17	5	3	86
	6-11	5-15	1.20-1.50	2-6	0.13-0.18	Low	2.0-4.0	.17	.17			
	11-14	5-15	1.20-1.50	2-6	0.13-0.18	Low	1.0-2.0	.17	.17			
	14-18	2-10	1.30-1.60	6-20	0.06-0.11	Low	0.8-1.5	.17	.17			
	18-25	2-10	1.30-1.60	6-20	0.06-0.11	Low	0.5-1.0	.17	.17			
	25-31	20-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
	31-39	20-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
	39-60	20-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
2192:												
Kratka----------------	0-6	5-15	1.20-1.50	2-6	0.13-0.18	Low	2.0-5.0	.17	.17	5	3	86
	6-11	5-15	1.20-1.50	2-6	0.13-0.18	Low	2.0-4.0	.17	.17			
	11-14	5-15	1.20-1.50	2-6	0.13-0.18	Low	1.0-2.0	.17	.17			
	14-18	2-10	1.30-1.60	6-20	0.06-0.11	Low	0.8-1.5	.17	.17			
	18-25	2-10	1.30-1.60	6-20	0.06-0.11	Low	0.5-1.0	.17	.17			
	25-31	10-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
	31-39	10-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
	39-60	10-35	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			

Table 20.—Physical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Moist bulk density	Ksat	Available water capacity	Shrink-swell potential	Organic matter	Erosion factors Kw	Kf	T	Wind erodibility group	Wind erodibility index
	In	Pct	g/cc	In/hr	In/in		Pct					
2192:(cont.)												
Wyndmere--------------	0-8	5-15	1.10-1.35	2-6	0.13-0.18	Low	5.0-8.0	.20	.20	5	3	86
	8-15	5-15	1.10-1.35	2-6	0.13-0.18	Low	1.0-4.0	.20	.20			
	15-26	5-15	1.30-1.50	2-6	0.12-0.17	Low	1.0-2.0	.24	.24			
	26-60	10-30	1.50-1.70	0.2-2	0.11-0.19	Moderate	0.0-0.5	.32	.32			
2193:												
Dumps, mine-----------	0-4	15-35	1.40-1.60	0.06-2	0.16-0.18	Moderate	0.5-1.0	.37	.37	5	4L	86
	4-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-1.0	.37	.37			
Ustorthents-----------	0-4	15-35	1.40-1.60	0.2-2	0.17-0.22	Low	0.5-2.0	.37	.37	5	4L	86
	4-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-0.5	.37	.37			
2194:												
Haplustolls-----------	0-16	15-35	1.40-1.60	0.2-2	0.17-0.22	Low	0.0-4.0	.32	.32	5	4L	86
	16-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-0.5	.37	.37			
Ustorthents-----------	0-4	15-35	1.40-1.60	0.2-2	0.17-0.22	Low	0.5-2.0	.37	.37	5	4L	86
	4-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-0.5	.37	.37			
2195:												
Ustorthents-----------	0-4	15-35	1.40-1.60	0.2-2	0.17-0.22	Low	0.5-2.0	.37	.37	5	4L	86
	4-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-0.5	.37	.37			
Haplustolls-----------	0-16	15-35	1.40-1.60	0.2-2	0.17-0.22	Low	0.0-4.0	.32	.32	5	4L	86
	16-60	15-35	1.40-1.80	0.06-0.6	0.10-0.13	Moderate	0.0-0.5	.37	.37			
2227:												
Swenoda---------------	0-9	10-20	1.10-1.35	2-6	0.13-0.18	Low	3.0-7.0	.20	.20	5	3	86
	9-13	10-20	1.10-1.35	2-6	0.13-0.18	Low	3.0-6.0	.20	.20			
	13-19	5-18	1.30-1.45	2-6	0.10-0.17	Low	1.0-3.0	.20	.20			
	19-29	5-18	1.30-1.45	2-6	0.10-0.17	Low	0.5-1.0	.20	.20			
	29-33	5-18	1.30-1.45	2-6	0.10-0.17	Low	0.5-1.0	.20	.20			
	33-39	20-35	1.35-1.65	0.2-2	0.16-0.22	Moderate	0.0-1.0	.37	.37			
	39-60	20-35	1.35-1.65	0.2-2	0.16-0.22	Moderate	0.0-1.0	.37	.37			

Table 21.—Chemical Properties of the Soils

(Dashes (—) indicate that data were not available or were not estimated.)

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
110:								
Barnes---------------	0-7	18-27	15-30	6.6-7.8	0	0	0	0
	7-19	18-35	15-30	6.1-7.8	0-3	0	0	0
	19-37	18-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0
	37-60	18-35	10-25	7.4-8.4	15-25	0-1	0.0-4.0	0
111:								
Barnes---------------	0-7	18-27	15-30	6.6-7.8	0	0	0	0
	7-19	18-35	15-30	6.1-7.8	0-3	0	0	0
	19-37	18-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0
	37-60	18-35	10-25	7.4-8.4	15-25	0-1	0.0-4.0	0
120:								
Barnes---------------	0-7	18-27	15-30	6.6-7.8	0	0	0	0
	7-19	18-35	15-30	6.1-7.8	0-3	0	0	0
	19-37	18-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0
	37-60	18-35	10-25	7.4-8.4	15-25	0-1	0.0-4.0	0
Buse-----------------	0-8	18-27	10-30	6.6-8.4	1-10	0	0	0
	8-40	18-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0
	40-60	18-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
470:								
Cresbard-------------	0-9	20-26	20-25	5.6-7.3	0	0	0.0-2.0	0
	9-14	20-35	15-30	5.6-7.3	0	0	0.0-2.0	0
	14-34	35-50	20-40	5.6-7.8	0	0	2.0-4.0	5-15
	34-55	28-40	15-30	7.4-8.4	10-20	1-5	2.0-4.0	5-15
	55-60	22-35	15-25	7.4-9.0	10-20	1-5	2.0-8.0	5-15
Barnes---------------	0-7	18-27	10-30	6.6-7.8	0	0	0	0
	7-19	18-35	10-30	6.1-7.8	0-3	0	0	0
	19-37	18-35	5-25	7.4-8.4	10-30	0-1	0.0-4.0	0
	37-60	18-35	5-25	7.4-8.4	15-25	0-1	0.0-4.0	0
674:								
Farnuf---------------	0-9	20-27	15-20	6.1-7.3	0	0	0	0
	9-23	25-35	20-25	6.1-7.8	0-5	0	0	0
	23-34	25-35	15-20	7.4-8.4	5-15	0	0.0-2.0	0
	34-60	15-35	10-20	7.4-8.4	5-10	0	0.0-2.0	0
676:								
Farnuf---------------	0-9	20-27	15-20	6.1-7.3	0	0	0	0
	9-23	25-35	20-25	6.1-7.8	0-5	0	0	0
	23-34	25-35	15-20	7.4-8.4	5-15	0	0.0-2.0	0
	34-60	15-35	10-20	7.4-8.4	5-10	0	0.0-2.0	0
Sakakawea------------	0-6	12-26	10-25	6.6-8.4	5-25	0	0	0
	6-21	12-26	5-20	6.6-8.4	10-45	0	0	0
	21-41	12-26	5-20	6.6-8.4	5-30	0-2	0.0-4.0	0
	41-60	10-45	5-30	7.9-8.4	5-30	0-2	0.0-4.0	0
882:								
Hamerly--------------	0-8	18-27	15-30	6.6-8.4	0-10	0	0.0-2.0	0
	8-35	18-35	10-20	7.4-8.4	15-35	0-2	0.0-4.0	0-2
	35-60	18-35	10-20	7.4-8.4	10-30	0-2	0.0-4.0	0-2

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
882:(cont.)								
Tonka----------------	0-13	18-27	10-40	5.6-7.4	0	0	0	0
	13-19	18-27	10-40	5.6-7.4	0	0	0	0
	19-34	35-45	20-35	5.6-7.4	0	0	0	0
	34-50	18-39	10-30	6.6-7.8	0-3	0-2	0.0-2.0	0-2
	50-60	18-39	10-30	6.6-8.4	1-10	0-2	0.0-2.0	0-2
975:								
Heil-----------------	0-3	18-27	15-30	5.6-7.3	0	0	0.0-2.0	0
	3-24	45-60	20-35	6.1-9.0	0-5	0	4.0-16.0	13-25
	24-38	27-50	15-40	7.4-9.0	3-15	0	4.0-16.0	5-15
	38-52	27-50	15-40	7.4-9.0	3-15	0-5	4.0-16.0	5-15
	52-60	20-50	10-40	7.4-9.0	3-15	0-5	4.0-16.0	5-15
1267:								
Marysland------------	0-9	18-27	15-35	7.4-8.4	3-15	0	0	0
	9-12	18-27	15-35	7.9-8.4	10-25	0	0	0
	12-15	18-27	10-25	7.9-8.4	15-35	0-3	0.0-2.0	0
	15-20	18-27	10-25	7.9-8.4	15-35	0-3	0.0-2.0	0
	20-27	18-27	10-25	7.9-8.4	15-35	0-3	0.0-2.0	0
	27-40	1-5	2-10	7.9-8.4	5-20	0	0	0
	40-60	1-5	2-10	7.9-8.4	5-20	0	0	0
1427:								
Parnell--------------	0-15	27-40	25-45	6.1-7.8	0	0	0	0
	15-22	18-40	25-45	6.1-7.8	0	0	0	0
	22-32	27-60	20-45	6.1-7.8	0	0	0	0
	32-55	27-60	20-45	6.1-7.8	0	0	0	0
	55-60	35-45	15-30	6.6-8.4	0-3	0-2	0	0
1439:								
Parshall-------------	0-12	5-20	7-15	5.6-7.8	0	0	0	0
	12-29	5-18	5-13	6.1-8.4	0-1	0	0	0
	29-48	5-18	5-10	7.4-8.4	0-10	0	0	0
	48-60	5-15	2-5	6.6-8.4	0-10	0	0	0
1466:								
Pits, sand and gravel	0-6	5-15	2-12	6.6-8.4	0-3	0	0	0
	6-60	0-15	1-10	6.6-8.4	5-20	0	0	0
1709:								
Southam--------------	0-16	15-26	20-50	6.6-8.4	0-10	0-1	2.0-8.0	0-2
	16-40	35-50	25-65	6.6-8.4	3-25	0-1	2.0-8.0	0-2
	40-60	18-50	15-45	7.4-8.4	10-30	0-5	2.0-8.0	0-2
1739:								
Straw----------------	0-5	18-27	15-30	6.6-7.3	0-1	0	0.0-2.0	0
	5-23	18-27	15-30	6.6-7.8	0-5	0	0.0-2.0	0
	23-30	18-34	15-25	7.4-8.4	1-10	0	0.0-2.0	0
	30-36	18-34	15-25	7.4-8.4	3-10	0	0.0-2.0	0
	36-40	18-34	15-25	6.6-8.4	3-10	0	0.0-4.0	0-5
	40-66	18-34	15-25	7.4-8.4	3-10	0-2	0.0-4.0	0-5
1835:								
Tonka----------------	0-13	18-27	10-40	5.6-7.4	0	0	0	0
	13-19	18-27	10-40	5.6-7.4	0	0	0	0
	19-34	35-45	20-35	5.6-7.4	0	0	0	0
	34-50	18-39	10-30	6.6-7.8	0-3	0-2	0.0-2.0	0-2
	50-60	18-39	10-30	6.6-8.4	1-10	0-2	0.0-2.0	0-2

Table 21.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
1871:								
Vallers, saline------	0-9	18-27	20-40	7.4-8.4	5-10	0-1	4.0-16.0	0
	9-44	18-35	10-30	7.4-8.4	15-30	0-2	4.0-16.0	0-5
	44-60	18-35	10-20	7.4-8.4	15-30	0-2	4.0-16.0	0-10
1883:								
Vallers--------------	0-9	18-27	20-40	7.4-8.4	5-10	0-1	0.0-4.0	0
	9-44	18-35	10-30	7.4-8.4	15-30	0-2	0.0-4.0	0-5
	44-60	18-35	10-20	7.4-8.4	15-30	0-2	0.0-4.0	0-10
Parnell--------------	0-15	27-40	25-45	6.1-7.8	0	0	0	0
	15-22	18-40	25-45	6.1-7.8	0	0	0	0
	22-32	27-60	20-45	6.1-7.8	0	0	0	0
	32-55	27-60	20-45	6.1-7.8	0	0	0	0
	55-60	35-45	15-30	6.6-8.4	0-3	0-2	0	0
1978:								
Water----------------	—	—	—	—	—	—	—	—
2014:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Bowbells-------------	0-6	18-27	15-25	6.1-7.3	0	0	0	0
	6-14	20-35	15-25	6.1-7.8	0-5	0	0	0
	14-23	20-35	15-25	6.1-7.8	0-5	0	0	0
	23-36	20-35	15-25	7.4-8.4	15-30	0-1	0	0
	36-60	20-35	15-25	7.4-8.4	5-20	0-1	0.0-2.0	0-1
2015:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Bowbells-------------	0-6	18-27	15-25	6.1-7.3	0	0	0	0
	6-14	20-35	15-25	6.1-7.8	0-5	0	0	0
	14-23	20-35	15-25	6.1-7.8	0-5	0	0	0
	23-36	20-35	15-25	7.4-8.4	15-30	0-1	0	0
	36-60	20-35	15-25	7.4-8.4	5-20	0-1	0.0-2.0	0-1
2023:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2023:(cont.)								
Niobell--------------	0-6	10-27	10-25	5.6-7.3	0	0	0	0
	6-9	10-27	10-25	5.6-7.3	0	0	0	0
	9-19	35-50	20-40	6.5-8.4	0-5	0-2	2.0-4.0	1-15
	19-29	35-50	15-25	7.9-9.0	10-20	0-3	2.0-4.0	5-10
	29-60	18-30	10-15	7.9-9.0	10-20	0-3	2.0-8.0	5-10
2024:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Niobell--------------	0-6	10-27	10-25	5.6-7.3	0	0	0	0
	6-9	10-27	10-25	5.6-7.3	0	0	0	0
	9-19	35-50	20-40	6.5-8.4	0-5	0-2	2.0-4.0	1-15
	19-29	35-50	15-25	7.9-9.0	10-20	0-3	2.0-4.0	5-10
	29-60	18-30	10-15	7.9-9.0	10-20	0-3	2.0-8.0	5-10
2031:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
2081:								
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
2130:								
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2130:(cont.)								
Parnell--------------	0-15	27-40	25-45	6.1-7.8	0	0	0	0
	15-22	18-40	25-45	6.1-7.8	0	0	0	0
	22-32	27-60	20-45	6.1-7.8	0	0	0	0
	32-55	27-60	20-45	6.1-7.8	0	0	0	0
	55-60	35-45	15-30	6.6-8.4	0-3	0-2	0	0
2131:								
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
Williams-------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Parnell--------------	0-15	27-40	25-45	6.1-7.8	0	0	0	0
	15-22	18-40	25-45	6.1-7.8	0	0	0	0
	22-32	27-60	20-45	6.1-7.8	0	0	0	0
	32-55	27-60	20-45	6.1-7.8	0	0	0	0
	55-60	35-45	15-30	6.6-8.4	0-3	0-2	0	0
2169:								
Harriet--------------	0-2	12-25	13-23	6.6-8.4	0-5	0	0.0-2.0	0
	2-18	35-50	17-26	7.4-9.0	1-15	0-5	4.0-16.0	13-25
	18-28	18-40	12-17	7.9-9.0	5-25	0-5	4.0-16.0	5-15
	28-38	10-18	5-15	7.9-9.0	3-15	0-5	8.0-16.0	5-15
	38-40	27-35	15-30	7.9-9.0	3-15	0-5	8.0-16.0	5-15
	40-60	18-45	13-19	7.9-9.0	3-15	0-5	8.0-16.0	5-15
Regan----------------	0-9	18-27	10-30	7.4-8.4	5-25	0	0.0-4.0	0
	9-28	18-35	10-25	7.4-8.4	15-35	0-2	4.0-16.0	0-5
	28-60	18-35	10-25	7.4-8.4	5-30	0-5	4.0-16.0	0-5
Stirum---------------	0-7	10-20	10-20	7.4-8.4	1-10	0	2.0-8.0	0-2
	7-15	10-20	5-15	7.9-9.0	10-25	0-2	2.0-16.0	10-20
	15-26	10-27	5-10	7.9-9.0	10-35	0-4	2.0-16.0	5-15
	26-34	5-20	5-10	7.9-9.0	5-20	0-4	2.0-16.0	5-15
	34-44	5-27	5-10	7.9-9.0	10-35	0-4	2.0-16.0	5-15
	44-60	5-20	5-10	7.9-9.0	5-25	0-4	2.0-16.0	5-15
2170:								
Divide---------------	0-8	18-27	15-35	7.4-8.4	0-10	0	0	0
	8-12	18-30	10-25	7.4-8.4	5-25	0	0	0
	12-22	18-30	10-25	7.4-8.4	15-35	0	0.0-4.0	0
	22-26	0-10	2-10	7.4-8.4	1-10	0	0	0
	26-60	0-10	2-10	7.4-8.4	1-5	0	0	0
2171:								
Sakakawea------------	0-6	12-26	10-25	6.6-8.4	5-25	0	0	0
	6-21	12-26	5-20	6.6-8.4	10-45	0	0	0
	21-41	12-26	5-20	6.6-8.4	5-30	0-2	0.0-4.0	0
	41-60	10-45	5-30	7.9-8.4	5-30	0-2	0.0-4.0	0

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2171:(cont.)								
Farnuf	0-9	20-27	15-20	6.1-7.3	0	0	0	0
	9-23	25-35	20-25	6.1-7.8	0-5	0	0	0
	23-34	25-35	15-20	7.4-8.4	5-15	0	0.0-2.0	0
	34-60	15-35	10-15	7.4-8.4	5-10	0	0.0-2.0	0
2172:								
Sakakawea	0-6	12-26	10-25	6.6-8.4	5-25	0	0	0
	6-21	12-26	5-20	6.6-8.4	10-45	0	0	0
	21-41	12-26	5-20	6.6-8.4	5-30	0-2	0.0-4.0	0
	41-60	10-45	5-30	7.9-8.4	5-30	0-2	0.0-4.0	0
Farnuf	0-9	20-27	15-20	6.1-7.3	0	0	0	0
	9-23	25-35	20-25	6.1-7.8	0-5	0	0	0
	23-34	25-35	15-20	7.4-8.4	5-15	0	0.0-2.0	0
	34-60	15-35	10-15	7.4-8.4	5-10	0	0.0-2.0	0
2173:								
Marias	0-6	40-60	25-55	7.4-8.4	1-5	—	0.0-4.0	1-4
	6-11	40-60	25-50	7.9-8.4	2-10	—	0.0-4.0	1-4
	11-27	40-60	25-45	7.9-9.0	2-10	1-5	2.0-4.0	4-8
	27-60	40-60	25-45	7.9-9.0	2-10	1-5	2.0-8.0	4-13
2174:								
Marias	0-6	40-60	25-55	7.4-8.4	1-5	—	0.0-4.0	1-4
	6-11	40-60	25-50	7.9-8.4	2-10	—	0.0-4.0	1-4
	11-27	40-60	25-45	7.9-9.0	2-10	1-5	2.0-4.0	4-8
	27-60	40-60	25-45	7.9-9.0	2-10	1-5	2.0-8.0	4-13
2175:								
Zahl	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
Williams	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
2176:								
Zahl	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
Williams	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
2177:								
Zahl	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon-ate	Gypsum	Salinity	Sodium adsorp-tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2177:(cont.)								
Williams--------------	0-6	15-27	15-30	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Vallers---------------	0-9	18-27	20-40	7.4-8.4	5-10	0-1	0.0-4.0	0
	9-44	18-35	10-30	7.4-8.4	15-30	0-2	0.0-4.0	0-5
	44-60	18-35	10-20	7.4-8.4	15-30	0-2	0.0-4.0	0-10
2178:								
Farnuf----------------	0-9	20-27	15-20	6.1-7.3	0	0	0	0
	9-23	25-35	20-25	6.1-7.8	0-5	0	0	0
	23-34	25-35	15-20	7.4-8.4	5-15	0	0.0-2.0	0
	34-60	15-35	10-15	7.4-8.4	5-10	0	0.0-2.0	0
Alkabo----------------	0-6	18-27	15-35	6.1-7.3	0	0	0	0
	6-9	10-27	8-30	6.1-7.3	0	0	0	0
	9-17	20-35	15-30	6.6-7.8	0	0	0	3-15
	17-45	20-35	15-30	7.9-9.0	0-15	0-3	2.0-8.0	3-15
	45-60	20-35	15-25	7.9-9.0	0-10	0-3	2.0-8.0	3-15
2179:								
Noonan----------------	0-6	18-27	10-25	5.6-7.3	0	0	0	0
	6-9	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	9-12	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	12-20	27-35	10-20	7.4-9.0	10-30	0-2	0.0-4.0	5-20
	20-28	20-30	10-15	7.4-9.0	10-30	0-2	2.0-8.0	5-20
	28-60	20-30	10-15	7.4-9.0	10-25	0-3	2.0-8.0	5-20
Niobell---------------	0-6	10-27	10-25	5.6-7.3	0	0	0	0
	6-9	10-27	10-25	5.6-7.3	0	0	0	0
	9-19	35-50	20-40	6.5-8.4	0-5	0-2	2.0-4.0	1-15
	19-29	35-50	15-25	7.9-9.0	10-20	0-3	2.0-4.0	5-10
	29-60	18-30	10-15	7.9-9.0	10-20	0-3	2.0-8.0	5-10
2180:								
Niobell---------------	0-6	10-27	10-25	5.6-7.3	0	0	0	0
	6-9	10-27	10-25	5.6-7.3	0	0	0	0
	9-19	35-50	20-40	6.5-8.4	0-5	0-2	2.0-4.0	1-15
	19-29	35-50	15-25	7.9-9.0	10-20	0-3	2.0-4.0	5-10
	29-60	18-30	10-15	7.9-9.0	10-20	0-3	2.0-8.0	5-10
Noonan----------------	0-6	18-27	10-25	5.6-7.3	0	0	0	0
	6-9	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	9-12	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	12-20	27-35	10-20	7.4-9.0	10-30	0-2	0.0-4.0	5-20
	20-28	20-30	10-15	7.4-9.0	10-30	0-2	2.0-8.0	5-20
	28-60	20-30	10-15	7.4-9.0	10-25	0-3	2.0-8.0	5-20
Tonka-----------------	0-13	18-27	10-40	5.6-7.4	0	0	0	0
	13-19	18-27	10-40	5.6-7.4	0	0	0	0
	19-34	35-45	20-35	5.6-7.4	0	0	0	0
	34-50	18-39	10-30	6.6-7.8	0-3	0-2	0.0-2.0	0-2
	50-60	18-39	10-30	6.6-8.4	1-10	0-2	0.0-2.0	0-2

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2181:								
Miranda--------------	0-4	18-26	15-25	6.1-7.3	0	0	0	0-3
	4-10	32-45	20-40	6.6-8.4	0-1	0-2	2.0-8.0	10-25
	10-16	32-45	20-40	7.9-8.4	0-3	1-3	4.0-16.0	10-25
	16-30	25-35	15-30	8.4-9.0	5-20	2-5	4.0-16.0	10-25
	30-60	18-35	10-30	8.4-9.0	5-15	2-5	4.0-16.0	10-40
Noonan---------------	0-6	18-27	10-25	5.6-7.3	0	0	0	0
	6-9	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	9-12	27-35	10-20	6.6-9.0	0-3	0	0.0-4.0	5-20
	12-20	27-35	10-20	7.4-9.0	10-30	0-2	0.0-4.0	5-20
	20-28	20-30	10-15	7.4-9.0	10-30	0-2	2.0-8.0	5-20
	28-60	20-30	10-15	7.4-9.0	10-25	0-3	2.0-8.0	5-20
2182:								
Portal---------------	0-6	10-18	8-20	6.1-7.3	0	0	0	0
	6-8	5-12	5-15	6.1-7.3	0	0	0	0
	8-12	10-18	8-18	7.4-8.4	0-1	0	2.0-8.0	5-15
	12-22	10-18	6-16	7.9-9.0	3-10	0-1	4.0-8.0	5-20
	22-40	10-18	6-16	7.9-9.0	5-15	0-3	4.0-8.0	5-15
	40-60	10-18	6-15	7.9-9.0	3-10	0-3	4.0-16.0	5-15
Lihen----------------	0-9	5-15	5-15	5.6-7.8	0-1	0	0	0
	9-24	3-10	2-12	6.1-8.4	0-5	0	0	0
	24-32	3-10	2-10	7.4-8.4	2-10	0	0	0
	32-60	3-10	2-7	7.4-8.4	0-10	0	0.0-2.0	0
2183:								
Lihen----------------	0-9	0-10	2-12	6.1-7.8	0-1	0	0	0
	9-24	3-10	2-12	6.1-8.4	0-5	0	0	0
	24-32	3-10	2-10	7.4-8.4	2-10	0	0	0
	32-60	3-10	0-7	7.4-8.4	0-10	0	0.0-2.0	0
Blanchard------------	0-3	2-5	1-5	5.6-7.8	0	0	0	0
	3-60	0-5	1-3	6.6-7.8	1-5	0	0	0
2184:								
Williams-------------	0-6	5-20	5-25	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
2185:								
Williams-------------	0-6	5-20	5-25	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5

Table 21.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2185:(cont.)								
Zahl-----------------	0-5	18-27	10-20	6.6-8.4	1-10	0	0	0
	5-20	20-30	10-15	7.4-8.4	15-35	0-2	0	0
	20-60	20-30	10-15	7.4-8.4	5-25	0-2	0.0-2.0	0-1
Lihen----------------	0-9	5-15	5-15	5.6-7.8	0-1	0	0	0
	9-24	3-10	2-12	6.1-8.4	0-5	0	0	0
	24-32	3-10	2-10	7.4-8.4	2-10	0	0	0
	32-60	3-10	2-7	7.4-8.4	0-10	0	0.0-2.0	0
2186:								
Lehr-----------------	0-6	10-27	15-30	6.6-7.8	0	0	0	0
	6-11	18-30	10-30	6.6-7.8	0-5	0	0	0
	11-15	18-30	10-30	6.6-8.4	0-15	0	0	0
	15-22	0-10	0-5	7.4-8.4	0-10	0	0	0
	22-60	0-10	0-5	7.4-8.4	0-10	0	0	0
Wabek----------------	0-5	10-27	15-30	6.6-7.8	0	0	0	0
	5-9	5-15	1-5	7.4-8.4	1-10	0	0	0
	9-60	0-10	0-5	7.4-8.4	1-10	0	0	0
2187:								
Appam----------------	0-6	6-18	5-20	6.1-7.3	0	0	0	0
	6-15	6-18	5-20	6.6-7.8	0	0	0	0
	15-19	6-18	5-15	7.4-8.4	2-15	0	0	0
	19-60	0-10	1-5	7.4-8.4	1-5	0	0	0
Wabek----------------	0-5	0-18	5-10	6.6-8.4	0-5	0	0	0
	5-9	5-15	1-5	7.4-8.4	1-10	0	0	0
	9-60	0-10	0-5	7.4-8.4	1-10	0	0	0
2188:								
Wabek----------------	0-5	0-18	5-10	6.6-8.4	0-5	0	0	0
	5-9	5-15	1-5	7.4-8.4	1-10	0	0	0
	9-60	0-10	0-5	7.4-8.4	1-10	0	0	0
Lehr-----------------	0-6	10-27	15-30	6.6-7.8	0	0	0	0
	6-11	18-30	10-30	6.6-7.8	0-5	0	0	0
	11-15	18-30	10-30	6.6-8.4	0-15	0	0	0
	15-22	0-10	0-5	7.4-8.4	0-10	0	0	0
	22-60	0-10	0-5	7.4-8.4	0-10	0	0	0
2189:								
Wabek----------------	0-5	0-18	5-10	6.6-8.4	0-5	0	0	0
	5-9	5-15	1-5	7.4-8.4	1-10	0	0	0
	9-60	0-10	0-5	7.4-8.4	0-10	0	0	0
Appam----------------	0-6	6-18	5-20	6.1-7.3	0	0	0	0
	6-15	6-18	5-20	6.6-7.8	0	0	0	0
	15-19	6-18	5-15	7.4-8.4	2-15	0	0	0
	19-60	0-10	1-5	7.4-8.4	1-5	0	0	0

Table 21.—Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2190:								
Williams-------------	0-6	5-20	5-25	6.6-7.8	0	0	0	0
	6-10	24-35	10-30	6.6-7.8	0-5	0	0	0
	10-15	24-35	10-30	6.6-7.8	0-5	0	0	0
	15-24	24-35	10-30	7.4-8.4	15-30	0	0	0
	24-36	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	36-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
2191:								
Towner---------------	0-9	2-10	5-10	6.6-7.8	0	0	0	0
	9-20	2-10	5-10	6.6-7.8	0	0	0	0
	20-29	2-10	2-5	6.6-7.8	0	0	0	0
	29-36	18-40	10-20	7.4-8.4	10-30	0-2	0.0-2.0	0
	36-60	18-40	10-20	7.4-8.4	10-30	0-2	0.0-2.0	0
Kratka---------------	0-6	5-15	5-15	5.6-7.8	0	0	0	0
	6-11	5-15	5-15	5.6-7.8	0	0	0	0
	11-14	5-15	5-15	5.6-7.8	0	0	0	0
	14-18	2-10	2-10	5.6-7.8	0	0	0	0
	18-25	2-10	2-10	5.6-7.8	0-1	0-1	0.0-2.0	0
	25-31	20-35	10-25	7.4-8.4	0-3	0-1	0.0-2.0	0
	31-39	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	39-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
2192:								
Kratka---------------	0-6	5-15	5-15	5.6-7.8	0	0	0	0
	6-11	5-15	5-15	5.6-7.8	0	0	0	0
	11-14	5-15	5-15	5.6-7.8	0	0	0	0
	14-18	2-10	2-10	5.6-7.8	0	0	0	0
	18-25	2-10	2-10	5.6-7.8	0-1	0-1	0.0-2.0	0
	25-31	20-35	10-25	7.4-8.4	0-3	0-1	0.0-2.0	0
	31-39	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
	39-60	20-35	10-25	7.4-8.4	5-20	0-2	0.0-2.0	0-5
Wyndmere-------------	0-8	5-15	10-25	6.6-8.4	10-20	0-1	0	0-1
	8-15	5-15	10-25	6.6-8.4	10-20	0-1	0	0-1
	15-26	5-15	3-20	7.4-8.4	15-35	0-1	0.0-2.0	0-1
	26-60	10-30	—	7.4-8.4	—	—	—	—
2193:								
Dumps, mine----------	0-4	15-35	10-25	6.6-8.4	5-20	0-5	0.0-4.0	2-10
	4-60	15-35	5-25	6.6-8.4	10-30	1-5	4.0-16.0	2-20
Ustorthents----------	0-4	15-35	15-30	6.6-8.4	1-10	0-1	0.0-4.0	0
	4-60	15-35	5-25	7.4-8.4	10-25	0-2	2.0-8.0	1-10
2194:								
Haplustolls----------	0-16	15-35	15-30	6.6-7.8	0-5	0	0.0-2.0	0
	16-60	15-35	5-25	7.4-8.4	5-20	0-2	2.0-8.0	1-5
Ustorthents----------	0-4	15-35	15-30	6.6-8.4	1-10	0-1	0.0-4.0	0
	4-60	15-35	5-25	7.4-8.4	10-25	0-2	2.0-8.0	1-10
2195:								
Ustorthents----------	0-4	15-35	15-30	6.6-8.4	1-10	0-1	0.0-4.0	0
	4-60	15-35	5-25	7.4-8.4	10-25	0-2	2.0-8.0	1-10

Table 21.--Chemical Properties of the Soils--Continued

Map symbol and soil name	Depth	Clay	Cation exchange capacity	Soil reaction	Calcium carbon- ate	Gypsum	Salinity	Sodium adsorp- tion ratio
	In	Pct	meq/100 g	pH	Pct	Pct	mmhos/cm	
2195:(cont.)								
Haplustolls----------	0-16	15-35	15-30	6.6-7.8	0-5	0	0.0-2.0	0
	16-60	15-35	5-25	7.4-8.4	5-20	0-2	2.0-8.0	1-5
2227:								
Swenoda--------------	0-9	10-20	10-25	6.1-7.3	0	0	0	0
	9-13	10-20	10-25	6.1-7.3	0	0	0	0
	13-19	5-18	5-15	6.6-7.8	0-1	0	0	0
	19-29	5-18	5-15	6.6-7.8	0-1	0	0	0
	29-33	5-18	5-15	6.6-7.8	0-2	0	0.0-2.0	0
	33-39	20-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2
	39-60	20-35	10-25	7.4-8.4	10-30	0-1	0.0-4.0	0-2

Table 22.-Water Features

(Dashes (—) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table		Ponding			Flooding	
			Upper limit	Lower limit	Surface water depth	Duration	Frequency	Duration	Frequency
110:									
Barnes	B								
		April	4.0-6.0	> 6.0	—	—	—	—	—
		May	4.0-6.0	> 6.0	—	—	—	—	—
		June	4.0-6.0	> 6.0	—	—	—	—	—
111:									
Barnes	B								
		April	4.0-6.0	> 6.0	—	—	—	—	—
		May	4.0-6.0	> 6.0	—	—	—	—	—
		June	4.0-6.0	> 6.0	—	—	—	—	—
120:									
Barnes	B								
		All months	—	—	—	—	—	—	—
Buse	B								
		All months	—	—	—	—	—	—	—
470:									
Cresbard	C								
		January	4.0-6.0	> 6.0	—	—	—	—	—
		February	4.0-6.0	> 6.0	—	—	—	—	—
		March	4.0-6.0	> 6.0	—	—	—	—	—
		April	3.0-5.0	> 6.0	—	—	—	—	—
		May	3.0-5.0	> 6.0	—	—	—	—	—
		June	3.0-5.0	> 6.0	—	—	—	—	—
		July	4.0-6.0	> 6.0	—	—	—	—	—
		August	4.0-6.0	> 6.0	—	—	—	—	—
		September	4.0-6.0	> 6.0	—	—	—	—	—
		October	4.0-6.0	> 6.0	—	—	—	—	—
		November	4.0-6.0	> 6.0	—	—	—	—	—
		December	4.0-6.0	> 6.0	—	—	—	—	—
Barnes	B								
		April	4.0-6.0	> 6.0	—	—	—	—	—
		May	4.0-6.0	> 6.0	—	—	—	—	—
		June	4.0-6.0	> 6.0	—	—	—	—	—
674:									
Farnuf	B								
		All months	—	—	—	—	—	—	—
676:									
Farnuf	B								
		All months	—	—	—	—	—	—	—
Sakakawea	B								
		All months	—	—	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
882:									
Hamerly-------------------	C								
		January	3.5-5.0	> 6.0	—	—	—	—	—
		February	3.5-5.0	> 6.0	—	—	—	—	—
		March	3.5-5.0	> 6.0	—	—	—	—	—
		April	1.5-3.5	> 6.0	—	—	—	—	—
		May	1.5-3.5	> 6.0	—	—	—	—	—
		June	1.5-3.5	> 6.0	—	—	—	—	—
		July	3.5-5.0	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	3.5-5.0	> 6.0	—	—	—	—	—
		October	3.5-5.0	> 6.0	—	—	—	—	—
		November	3.5-5.0	> 6.0	—	—	—	—	—
		December	3.5-5.0	> 6.0	—	—	—	—	—
Tonka---------------------	C/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		April	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		June	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
975:									
Heil----------------------	D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	1.5-3.5	> 6.0	—	—	—	—	—
		April	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		May	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		June	0.0	> 6.0	0.0-0.5	Brief	Occasional	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	3.5-5.0	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
1267:									
Marysland-----------------	B/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	—	—
		April	0.0-1.5	> 6.0	—	—	—	—	—
		May	0.0-1.5	> 6.0	—	—	—	—	—
		June	0.0-1.5	> 6.0	—	—	—	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
1427:									
Parnell	D								
		January	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		February	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		March	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		April	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		May	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		June	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		July	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		August	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		September	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		October	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		November	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		December	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
1439:									
Parshall	B								
		All months	—	—	—	—	—	—	—
1466:									
Pits, sand and gravel	A								
		All months	—	—	—	—	—	—	—
1709:									
Southam	D								
		January	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		February	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		March	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		April	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		May	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		June	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		July	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		August	0.0-1.0	> 6.0	0.0-5.0	Long	Frequent	—	—
		September	0.0-1.0	> 6.0	0.0-5.0	Long	Frequent	—	—
		October	0.0-1.0	> 6.0	0.0-5.0	Long	Frequent	—	—
		November	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
		December	0.0	> 6.0	0.0-5.0	Very long	Frequent	—	—
1739:									
Straw	B								
		March	—	—	—	—	—	Brief	Rare
		April	3.5-5.0	> 6.0	—	—	—	Brief	Rare
		May	3.5-5.0	> 6.0	—	—	—	Brief	Rare
		June	3.5-5.0	> 6.0	—	—	—	Brief	Rare
		July	—	—	—	—	—	Brief	Rare
1835:									
Tonka	C/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		April	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		June	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
1871:									
Vallers, saline-----------	C								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	—	—
		April	0.0-1.5	> 6.0	—	—	—	—	—
		May	0.0-1.5	> 6.0	—	—	—	—	—
		June	0.0-1.5	> 6.0	—	—	—	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
1883:									
Vallers-------------------	C								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	—	—
		April	0.0-1.5	> 6.0	—	—	—	—	—
		May	0.0-1.5	> 6.0	—	—	—	—	—
		June	0.0-1.5	> 6.0	—	—	—	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
Parnell-------------------	D								
		January	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		February	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		March	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		April	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		May	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		June	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		July	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		August	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		September	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		October	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		November	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		December	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
1978:									
Water---------------------	—								
		January	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		February	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		March	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		April	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		May	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		June	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		July	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		August	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		September	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		October	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		November	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		November	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—
		December	0.0	0.0-0.0	0.0-6.0	Very long	Frequent	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table Upper limit	Water Table Lower limit	Ponding Surface water depth	Ponding Duration	Ponding Frequency	Flooding Duration	Flooding Frequency
2014:									
Williams	B								
		All months	—	—	—	—	—	—	—
Bowbells	B								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2015:									
Williams	B								
		All months	—	—	—	—	—	—	—
Bowbells	B								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2023:									
Williams	B								
		All months	—	—	—	—	—	—	—
Niobell	C								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2024:									
Williams	B								
		All months	—	—	—	—	—	—	—
Niobell	C								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2031:									
Williams	B								
		All months	—	—	—	—	—	—	—
Zahl	B								
		All months	—	—	—	—	—	—	—
2081:									
Zahl	B								
		All months	—	—	—	—	—	—	—
Williams	B								
		All months	—	—	—	—	—	—	—
2130:									
Williams	B								
		All months	—	—	—	—	—	—	—
Zahl	B								
		All months	—	—	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2130:(cont.)									
Parnell-------------------	D								
		January	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		February	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		March	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		April	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		May	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		June	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		July	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		August	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		September	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		October	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		November	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		December	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
2131:									
Zahl----------------------	B								
		All months	—	—	—	—	—	—	—
Williams------------------	B								
		All months	—	—	—	—	—	—	—
Parnell-------------------	D								
		January	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		February	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		March	0.0	> 6.0	0.0-1.0	Long	Frequent	—	—
		April	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		May	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		June	0.0	> 6.0	0.0-2.0	Very long	Frequent	—	—
		July	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		August	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		September	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		October	0.0-1.5	> 6.0	0.0-1.0	Brief	Occasional	—	—
		November	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
		December	0.0-1.0	> 6.0	0.0-1.0	Long	Occasional	—	—
2169:									
Harriet-------------------	D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		April	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		May	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		June	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	3.5-5.0	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
Regan---------------------	C/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	Brief	Occasional
		April	0.0-1.5	> 6.0	—	—	—	Brief	Occasional
		May	0.0-1.5	> 6.0	—	—	—	Brief	Occasional
		June	0.0-1.5	> 6.0	—	—	—	Brief	Occasional
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	3.5-5.0	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2169:(cont.)									
Stirum	B/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		April	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		May	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		June	0.0-1.5	> 6.0	—	—	—	Long	Occasional
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
2170:									
Divide	B								
		January	3.5-5.0	> 6.0	—	—	—	—	—
		February	3.5-5.0	> 6.0	—	—	—	—	—
		March	3.5-5.0	> 6.0	—	—	—	—	—
		April	1.5-3.5	> 6.0	—	—	—	—	—
		May	1.5-3.5	> 6.0	—	—	—	—	—
		June	1.5-3.5	> 6.0	—	—	—	—	—
		July	3.5-5.0	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	3.5-5.0	> 6.0	—	—	—	—	—
		October	3.5-5.0	> 6.0	—	—	—	—	—
		November	3.5-5.0	> 6.0	—	—	—	—	—
		December	3.5-5.0	> 6.0	—	—	—	—	—
2171:									
Sakakawea	B								
		All months	—	—	—	—	—	—	—
Farnuf	B								
		All months	—	—	—	—	—	—	—
2172:									
Sakakawea	B								
		All months	—	—	—	—	—	—	—
Farnuf	B								
		All months	—	—	—	—	—	—	—
2173:									
Marias	D								
		All months	—	—	—	—	—	—	—
2174:									
Marias	D								
		All months	—	—	—	—	—	—	—
2175:									
Zahl	B								
		All months	—	—	—	—	—	—	—
Williams	B								
		All months	—	—	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2176:									
Zahl	B								
		All months	—	—	—	—	—	—	—
Williams	B								
		All months	—	—	—	—	—	—	—
2177:									
Zahl	B								
		All months	—	—	—	—	—	—	—
Williams	B								
		All months	—	—	—	—	—	—	—
Vallers	C								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	—	—	—	—	—
		April	0.0-1.5	> 6.0	—	—	—	—	—
		May	0.0-1.5	> 6.0	—	—	—	—	—
		June	0.0-1.5	> 6.0	—	—	—	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
2178:									
Farnuf	B								
		All months	—	—	—	—	—	—	—
Alkabo	C								
		All months	—	—	—	—	—	—	—
2179:									
Noonan	D								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
Niobell	C								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2180:									
Niobell	C								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
Noonan	D								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—

Table 22.-Water Features--Continued

(Dashes (—) indicate that an assignment has not been made. Depths of layers are in feet)

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2180:(cont.)									
Tonka----------------------	C/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		April	0.0	1.0-1.5	0.0-1.0	Long	Frequent	—	—
			1.5-2.0	> 6.0					
		May	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		June	0.0-1.5	> 6.0	0.0-1.0	Long	Frequent	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	3.5-5.0	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
2181:									
Miranda--------------------	D								
		April	1.5-3.0	> 6.0	—	—	—	—	—
		May	1.5-3.0	> 6.0	—	—	—	—	—
		June	1.5-3.0	> 6.0	—	—	—	—	—
		July	1.5-3.0	> 6.0	—	—	—	—	—
Noonan---------------------	D								
		April	3.5-5.0	> 6.0	—	—	—	—	—
		May	3.5-5.0	> 6.0	—	—	—	—	—
		June	3.5-5.0	> 6.0	—	—	—	—	—
2182:									
Portal---------------------	D								
		All months	—	—	—	—	—	—	—
Lihen----------------------	A								
		All months	—	—	—	—	—	—	—
2183:									
Lihen----------------------	A								
		All months	—	—	—	—	—	—	—
Blanchard------------------	A								
		All months	—	—	—	—	—	—	—
2184:									
Williams-------------------	B								
		All months	—	—	—	—	—	—	—
Zahl-----------------------	B								
		All months	—	—	—	—	—	—	—
2185:									
Williams-------------------	B								
		All months	—	—	—	—	—	—	—
Zahl-----------------------	B								
		All months	—	—	—	—	—	—	—
Lihen----------------------	A								
		All months	—	—	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table: Upper limit	Water Table: Lower limit	Ponding: Surface water depth	Ponding: Duration	Ponding: Frequency	Flooding: Duration	Flooding: Frequency
2186:									
Lehr	B								
		All months	—	—	—	—	—	—	—
Wabek	A								
		All months	—	—	—	—	—	—	—
2187:									
Appam	B								
		All months	—	—	—	—	—	—	—
Wabek	A								
		All months	—	—	—	—	—	—	—
2188:									
Wabek	A								
		All months	—	—	—	—	—	—	—
Lehr	B								
		All months	—	—	—	—	—	—	—
2189:									
Wabek	A								
		All months	—	—	—	—	—	—	—
Appam	B								
		All months	—	—	—	—	—	—	—
2190:									
Williams	B								
		All months	—	—	—	—	—	—	—
2191:									
Towner	B								
		April	3.0-5.0	3.0-5.0	—	—	—	—	—
		May	3.0-5.0	3.0-5.0	—	—	—	—	—
		June	3.0-5.0	3.0-5.0	—	—	—	—	—
Kratka	B/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	0.0-0.5	Long	Occasional	—	—
		April	0.0-1.5	> 6.0	0.0-0.5	Long	Occasional	—	—
		May	0.0-1.5	> 6.0	0.0-0.5	Brief	Occasional	—	—
		June	0.0-1.5	> 6.0	0.0-0.5	Brief	Rare	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—

Table 22.-Water Features--Continued

Map symbol and soil name	Hydro-logic group	Month	Water Table Upper limit	Water Table Lower limit	Ponding Surface water depth	Ponding Duration	Ponding Frequency	Flooding Duration	Flooding Frequency
2192:									
Kratka	B/D								
		January	1.5-3.5	> 6.0	—	—	—	—	—
		February	1.5-3.5	> 6.0	—	—	—	—	—
		March	0.0-1.5	> 6.0	0.0-0.5	Long	Occasional	—	—
		April	0.0-1.5	> 6.0	0.0-0.5	Long	Occasional	—	—
		May	0.0-1.5	> 6.0	0.0-0.5	Brief	Occasional	—	—
		June	0.0-1.5	> 6.0	0.0-0.5	Brief	Rare	—	—
		July	1.5-3.5	> 6.0	—	—	—	—	—
		August	1.5-3.5	> 6.0	—	—	—	—	—
		September	1.5-3.5	> 6.0	—	—	—	—	—
		October	1.5-3.5	> 6.0	—	—	—	—	—
		November	1.5-3.5	> 6.0	—	—	—	—	—
		December	1.5-3.5	> 6.0	—	—	—	—	—
Wyndmere	B								
		January	3.0-5.0	> 6.0	—	—	—	—	—
		February	3.0-5.0	> 6.0	—	—	—	—	—
		March	1.5-3.5	> 6.0	—	—	—	—	—
		April	1.5-3.5	> 6.0	—	—	—	—	—
		May	1.5-3.5	> 6.0	—	—	—	—	—
		June	1.5-3.5	> 6.0	—	—	—	—	—
		July	3.0-5.0	> 6.0	—	—	—	—	—
		August	3.0-5.0	> 6.0	—	—	—	—	—
		September	3.0-5.0	> 6.0	—	—	—	—	—
		October	3.0-5.0	> 6.0	—	—	—	—	—
		November	3.0-5.0	> 6.0	—	—	—	—	—
		December	3.0-5.0	> 6.0	—	—	—	—	—
2193:									
Dumps, mine	C								
		All months	—	—	—	—	—	—	—
Ustorthents	C								
		All months	—	—	—	—	—	—	—
2194:									
Haplustolls	C								
		All months	—	—	—	—	—	—	—
Ustorthents	C								
		All months	—	—	—	—	—	—	—
2195:									
Ustorthents	C								
		All months	—	—	—	—	—	—	—
Haplustolls	C								
		All months	—	—	—	—	—	—	—
2227:									
Swenoda	B								
		January	4.0-6.0	> 6.0	—	—	—	—	—
		February	4.0-6.0	> 6.0	—	—	—	—	—
		March	4.0-6.0	> 6.0	—	—	—	—	—
		April	3.0-5.0	> 6.0	—	—	—	—	—
		May	3.0-5.0	> 6.0	—	—	—	—	—
		June	3.0-5.0	> 6.0	—	—	—	—	—
		July	4.0-6.0	> 6.0	—	—	—	—	—
		August	4.0-6.0	> 6.0	—	—	—	—	—
		September	4.0-6.0	> 6.0	—	—	—	—	—
		October	4.0-6.0	> 6.0	—	—	—	—	—
		November	4.0-6.0	> 6.0	—	—	—	—	—
		December	4.0-6.0	> 6.0	—	—	—	—	—

Table 23.-Soil Features

(Dashes (—) indicate that an assignment has not been made.)

Map symbol and soil name	Restrictive layer				Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated steel	Concrete
		In	In				
110:							
Barnes	—	—	—	—	Moderate	Moderate	Low
111:							
Barnes	—	—	—	—	Moderate	Moderate	Low
120:							
Barnes	—	—	—	—	Moderate	Moderate	Low
Buse	—	—	—	—	Moderate	Moderate	Low
470:							
Cresbard	Natric	5-19	—	Very weakly cemented	Moderate	High	Moderate
Barnes	—	—	—	—	Moderate	Moderate	Low
674:							
Farnuf	—	—	—	—	Moderate	High	Low
676:							
Farnuf	—	—	—	—	Moderate	High	Low
Sakakawea	—	—	—	—	Moderate	High	Low
882:							
Hamerly	—	—	—	—	High	High	Low
Tonka	—	—	—	—	High	High	Low
975:							
Heil	Natric	1-4	—	Weakly cemented	Moderate	High	Moderate
1267:							
Marysland	—	—	—	—	High	High	Low
1427:							
Parnell	—	—	—	—	High	High	Low
1439:							
Parshall	—	—	—	—	Moderate	Moderate	Low
1466:							
Pits, sand and gravel	—	—	—	—	None	Low	Low
1709:							
Southam	—	—	—	—	High	High	Low
1739:							
Straw	—	—	—	—	Moderate	High	Low
1835:							
Tonka	—	—	—	—	High	High	Low
1871:							
Vallers, saline	—	—	—	—	High	High	Low
1883:							
Vallers	—	—	—	—	High	High	Low

Table 23.-Soil Features--Continued

Map symbol and soil name	Restrictive layer: Kind	Restrictive layer: Depth to top	Restrictive layer: Thickness	Restrictive layer: Hardness	Potential for frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
		In	In				
1883:(cont.)							
Parnell	—	—	—	—	High	High	Low
1978:							
Water	—	—	—	—	—	—	—
2014:							
Williams	—	—	—	—	Moderate	High	Low
Bowbells	—	—	—	—	Moderate	High	Low
2015:							
Williams	—	—	—	—	Moderate	High	Low
Bowbells	—	—	—	—	Moderate	High	Low
2023:							
Williams	—	—	—	—	Moderate	High	Low
Niobell	Natric	5-17	—	Very weakly cemented	Moderate	High	Moderate
2024:							
Williams	—	—	—	—	Moderate	High	Low
Niobell	Natric	5-17	—	Very weakly cemented	Moderate	High	Moderate
2031:							
Williams	—	—	—	—	Moderate	High	Low
Zahl	—	—	—	—	Moderate	Moderate	Low
2081:							
Zahl	—	—	—	—	Moderate	Moderate	Low
Williams	—	—	—	—	Moderate	High	Low
2130:							
Williams	—	—	—	—	Moderate	High	Low
Zahl	—	—	—	—	Moderate	Moderate	Low
Parnell	—	—	—	—	High	High	Low
2131:							
Zahl	—	—	—	—	Moderate	Moderate	Low
Williams	—	—	—	—	Moderate	High	Low
Parnell	—	—	—	—	High	High	Low
2169:							
Harriet	Natric	0-5	—	Weakly cemented	High	High	Moderate
Regan	—	—	—	—	High	High	Low
Stirum	Natric	3-13	—	Weakly cemented	Moderate	High	Moderate

Table 23.-Soil Features--Continued

Map symbol and soil name	Restrictive layer: Kind	Restrictive layer: Depth to top	Restrictive layer: Thickness	Restrictive layer: Hardness	Potential for frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
		In	In				
2170:							
Divide	—	—	—	—	Moderate	High	Low
2171:							
Sakakawea	—	—	—	—	Moderate	High	Low
Farnuf	—	—	—	—	Moderate	High	Low
2172:							
Sakakawea	—	—	—	—	Moderate	High	Low
Farnuf	—	—	—	—	Moderate	High	Low
2173:							
Marias	—	—	—	—	Low	High	Low
2174:							
Marias	—	—	—	—	Low	High	Low
2175:							
Zahl	—	—	—	—	Moderate	Moderate	Low
Williams	—	—	—	—	Moderate	High	Low
2176:							
Zahl	—	—	—	—	Moderate	Moderate	Low
Williams	—	—	—	—	Moderate	High	Low
2177:							
Zahl	—	—	—	—	Moderate	Moderate	Low
Williams	—	—	—	—	Moderate	High	Low
Vallers	—	—	—	—	High	High	Low
2178:							
Farnuf	—	—	—	—	Moderate	High	Low
Alkabo	Natric	5-18	—	Very weakly cemented	Moderate	High	Moderate
2179:							
Noonan	Natric	5-10	—	Weakly cemented	Moderate	High	Moderate
Niobell	Natric	5-17	—	Very weakly cemented	Moderate	High	Moderate
2180:							
Niobell	Natric	5-17	—	Very weakly cemented	Moderate	High	Moderate
Noonan	Natric	5-10	—	Weakly cemented	Moderate	High	Moderate
Tonka	—	—	—	—	High	High	Low

Table 23.-Soil Features--Continued

Map symbol and soil name	Restrictive layer				Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated steel	Concrete
		In	In				
2181:							
Miranda----------------	Natric	0-5	—	Weakly cemented	Moderate	High	Moderate
Noonan-----------------	Natric	5-10	—	Weakly cemented	Moderate	High	Moderate
2182:							
Portal-----------------	Natric	0-12	—	Weakly cemented	Moderate	High	Moderate
Lihen------------------	—	—	—	—	Low	High	Low
2183:							
Lihen------------------	—	—	—	—	Low	High	Low
Blanchard--------------	—	—	—	—	Low	Moderate	Moderate
2184:							
Williams---------------	—	—	—	—	Moderate	High	Low
Zahl-------------------	—	—	—	—	Moderate	Moderate	Low
2185:							
Williams---------------	—	—	—	—	Moderate	High	Low
Zahl-------------------	—	—	—	—	Moderate	Moderate	Low
Lihen------------------	—	—	—	—	Low	High	Low
2186:							
Lehr-------------------	—	—	—	—	Low	Moderate	Low
Wabek------------------	—	—	—	—	Low	Moderate	Low
2187:							
Appam------------------	—	—	—	—	Low	Moderate	Low
Wabek------------------	—	—	—	—	Low	Moderate	Low
2188:							
Wabek------------------	—	—	—	—	Low	Moderate	Low
Lehr-------------------	—	—	—	—	Low	Moderate	Low
2189:							
Wabek------------------	—	—	—	—	Low	Moderate	Low
Appam------------------	—	—	—	—	Low	Moderate	Low
2190:							
Williams---------------	—	—	—	—	Moderate	High	Low
2191:							
Towner-----------------	—	—	—	—	Moderate	High	Low
Kratka-----------------	—	—	—	—	Moderate	High	Low
2192:							
Kratka-----------------	—	—	—	—	Moderate	High	Low
Wyndmere---------------	—	—	—	—	High	Moderate	Low

Table 23.-Soil Features--Continued

Map symbol and soil name	Restrictive layer				Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness		Uncoated steel	Concrete
		In	In				
2193:							
Dumps, mine------------	Dense material	4-16	—	Weakly cemented	Moderate	High	Low
Ustorthents------------	Dense material	4-16	—	Weakly cemented	Moderate	High	Low
2194:							
Haplustolls------------	Dense material	16-24	—	Weakly cemented	Moderate	High	Low
Ustorthents------------	Dense material	4-16	—	Weakly cemented	Moderate	High	Low
2195:							
Ustorthents------------	Dense material	4-16	—	Weakly cemented	Moderate	High	Low
Haplustolls------------	Dense material	16-24	—	Weakly cemented	Moderate	High	Low
2227:							
Swenoda----------------	—	—	—	—	Moderate	High	Low

Table 24.-Hydric Soils List

See end of table for criteria codes and definitions.

There may be small areas of included soils or miscellaneous areas that are significant to use and management of the soil; yet are too small to delineate on the soil map at the map's original scale. These may be designated as spot symbols and are described on the conventional and special symbols legend.

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
110:							
Barnes loam, 0 to 3 percent slopes	Barnes	No	rise	—	—	—	—
	Cresbard	No	flat	—	—	—	—
	Svea	No	swale	—	—	—	—
	Swenoda	No	rise	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
111:							
Barnes loam, 3 to 6 percent slopes	Barnes	No	rise	—	—	—	—
	Buse	No	rise	—	—	—	—
	Svea	No	swale	—	—	—	—
	Swenoda	No	rise	—	—	—	—
	Cresbard	No	flat	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
120:							
Barnes-Buse loams, 6 to 9 percent slopes	Barnes	No	rise	—	—	—	—
	Buse	No	rise	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
470:							
Cresbard-Barnes loams, 0 to 3 percent slopes	Cresbard	No	flat	—	—	—	—
	Barnes	No	rise	—	—	—	—
	Hamlet	No	swale	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Wyard	No	swale	—	—	—	—
	Cavour	No	flat	—	—	—	—
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Vallers	Yes	flat	2B3	Yes	No	No
674:							
Farnuf loam, 0 to 3 percent slopes	Farnuf	No	flat	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
	Roseglen	No	flat	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Lehr	No	rise	—	—	—	—
	Marias	No	rise	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
676:							
Farnuf-Sakakawea loams, 3 to 6 percent slopes	Farnuf	No	flat	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
	Marias	No	flat	—	—	—	—
	Roseglen	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
	Williams	No	rise	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
882:							
Hamerly-Tonka complex, 0 to 3 percent slopes	Hamerly	No	rise	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
	Parnell	Yes	depression, moraine	3,2B3	Yes	No	Yes
	Vallers	Yes	flat	2B3	Yes	No	No
	Bowbells	No	swale	—	—	—	—
	Divide	No	drainageway, flat, terrace	—	—	—	—
	Niobell	No	swale, till plain	—	—	—	—
975:							
Heil silt loam, 0 to 1 percent slopes	Heil	Yes	depression	3,2B3	Yes	No	Yes
	Harriet	Yes	flood plain	2B3	Yes	No	No
	Exline	No	flat	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
	Parnell	Yes	depression	3,2B3	Yes	No	Yes
	Vallers, saline	Yes	flat	2B3	Yes	No	No
	Noonan	No	flat, swale	—	—	—	—
1267:							
Marysland loam, 0 to 1 percent slopes	Marysland	Yes	channel, swale	2B3	Yes	No	No
	Easby	Yes	flat	2B3	Yes	No	No
	Vallers	Yes	flat	2B3	Yes	No	No
	Divide	No	flat	—	—	—	—
	McDonaldsville	Yes	flat	2B3	Yes	No	No
1427:							
Parnell silty clay loam, 0 to 1 percent slopes	Parnell	Yes	depression, moraine	3,2B3	Yes	No	Yes
	Vallers	Yes	flat	2B3	Yes	No	No
	Grano	Yes	depression	2B3,3	Yes	No	Yes
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Heil	Yes	depression	2B3,3	Yes	No	Yes
	Miranda	No	flat	—	—	—	—
	Southam	Yes	depression	3,2B3	Yes	No	Yes
1439:							
Parshall fine sandy loam, 0 to 6 percent slopes	Parshall	No	flat, rise	—	—	—	—
	Dooley	No	flat, rise	—	—	—	—
	Portal	No	flat, terrace	—	—	—	—
	Hamerly	No	rise	—	—	—	—
	Lihen	No	rise, terrace	—	—	—	—
	Niobell	No	swale, till plain	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
1466:							
Pits, sand and gravel	Pits, sand and gravel	No	terrace	—	—	—	—
	Wabek	No	terrace	—	—	—	—
	Bowdle	No	terrace	—	—	—	—
	Lehr	No	terrace	—	—	—	—
1709:							
Southam silt loam, 0 to 1 percent slopes	Southam	Yes	depression	3,2B3	Yes	No	Yes
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Heil	Yes	depression	3,2B3	Yes	No	Yes
	Minnewaukan	Yes	flat	2B2	Yes	No	No
	Tonka	Yes	depression	2B3,3	Yes	No	Yes

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
1739:							
Straw loam, 0 to 3 percent slopes	Straw	No	flood plain	—	—	—	—
	Parnell	Yes	depression, moraine	2B3,3	Yes	No	Yes
	Korchea	No	flood plain	—	—	—	—
	Velva	No	terrace, flood plain	—	—	—	—
	Miranda	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Vallers	Yes	flat	2B3	Yes	No	No
1835:							
Tonka silt loam, 0 to 1 percent slopes	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Heil	Yes	depression	3,2B3	Yes	No	Yes
	Noonan	No	flat	—	—	—	—
	Parnell	Yes	depression	3,2B3	Yes	No	Yes
	Bowbells	No	swale	—	—	—	—
	Miranda	No	flat	—	—	—	—
1871:							
Vallers loam, saline, 0 to 1 percent slopes	Vallers, saline	Yes	flat	2B3	Yes	No	No
	Hamerly, saline	No	flat	—	—	—	—
	Hegne, saline	Yes	flat	2B3	Yes	No	No
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Hamlet	No	rise	—	—	—	—
	Harriet	Yes	flat	2B3	Yes	No	No
	Divide, saline	No	flat	—	—	—	—
1883:							
Vallers-Parnell complex, 0 to 1 percent slopes	Vallers	Yes	flat	2B3	Yes	No	No
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Divide	No	flat	—	—	—	—
	Harriet	Yes	flat	2B3	Yes	No	No
	Southam	Yes	depression	2B3,3	Yes	No	Yes
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Williams	No	knoll	—	—	—	—
1978:							
Water	Water	Yes	depression	2B3,3	Yes	No	Yes
2014:							
Williams-Bowbells loams, 0 to 3 percent slopes	Williams	No	rise	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Appam	No	rise	—	—	—	—
	Bowdle	No	flat	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Zahl	No	rise	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2015:							
Williams-Bowbells loams, 3 to 6 percent slopes	Williams	No	rise	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Parnell	Yes	depression, moraine	3,2B3	Yes	No	Yes
	Niobell	No	swale, till plain	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Hamerly	No	rise	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Vallers	Yes	flat	2B3	Yes	No	No
2023:							
Williams-Niobell loams, 0 to 3 percent slopes	Williams	No	flat	—	—	—	—
	Niobell	No	swale, till plain	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Zahl	No	rise	—	—	—	—
	Dooley	No	rise	—	—	—	—
	Heil	Yes	depression	3,2B3	Yes	No	Yes
2024:							
Williams-Niobell loams, 3 to 6 percent slopes	Williams	No	rise	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Zahl	No	rise	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Heil	Yes	depression	2B3,3	Yes	No	Yes
	Bowbells	No	swale	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
2031:							
Williams-Zahl loams, 3 to 6 percent slopes	Williams	No	rise	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Dooley	No	rise	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
2081:							
Zahl-Williams loams, 9 to 15 percent slopes	Zahl	No	knoll, ridge	—	—	—	—
	Williams	No	knoll, ridge	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Marias	No	rise	—	—	—	—
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Wabek	No	ridge	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2130:							
Williams-Zahl-Parnell complex, 0 to 9 percent slopes	Williams	No	knoll, ridge	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Parnell	Yes	depression	3,2B3	Yes	No	Yes
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
	Heil	Yes	depression	2B3,3	Yes	No	Yes
	Noonan	No	flat	—	—	—	—
	Southam	Yes	depression	3,2B3	Yes	No	Yes
2131:							
Zahl-Williams-Parnell complex, 0 to 35 percent slopes	Zahl	No	knoll, ridge, till plain	—	—	—	—
	Williams	No	knoll, ridge	—	—	—	—
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
	Southam	Yes	depression	3,2B3	Yes	No	Yes
	Bowbells	No	swale	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
2169:							
Harriet, Regan, and Stirum soils, 0 to 1 percent slopes	Harriet	Yes	drainageway, flood plain	2B3	Yes	No	No
	Regan	Yes	drainageway	2B3,3	Yes	No	Yes
	Stirum	Yes	drainageway, flood plain	2B3	Yes	No	No
	Miranda	No	flat	—	—	—	—
	Heil	Yes	depression	3,2B3	Yes	No	Yes
	Tiffany	Yes	depression	3,2B3	Yes	No	Yes
	Exline	No	flat	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Portal	No	rise	—	—	—	—
2170:							
Divide loam, 0 to 3 percent slopes	Divide	No	drainageway, flat, terrace	—	—	—	—
	Wyrene	No	flat	—	—	—	—
	Bowdle	No	terrace	—	—	—	—
	Appam	No	terrace	—	—	—	—
	Marysland	Yes	flat	2B3	Yes	No	No
	Hamerly	No	flat	—	—	—	—
	Wabek	No	rise	—	—	—	—
2171:							
Sakakawea-Farnuf loams, 6 to 9 percent slopes	Sakakawea	No	knoll, rise	—	—	—	—
	Farnuf	No	flat	—	—	—	—
	Roseglen	No	rise	—	—	—	—
	Williams	No	rise	—	—	—	—
	Marias	No	rise	—	—	—	—
	Lehr	No	terrace	—	—	—	—
	Wabek	No	terrace	—	—	—	—
2172:							
Sakakawea-Farnuf loams, 9 to 25 slopes	Sakakawea	No	knoll	—	—	—	—
	Farnuf	No	knoll	—	—	—	—
	Wabek	No	knoll	—	—	—	—
	Marias	No	flat	—	—	—	—
	Zahl	No	knoll	—	—	—	—
	Bryant	No	flat	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2173:							
Marias silty clay, 0 to 3 percent slopes	Marias	No	flat	—	—	—	—
	Farnuf	No	flat	—	—	—	—
	Wildrose	No	flat, lake plain	—	—	—	—
	Aberdeen	No	flat	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
	Grano	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
2174:							
Marias silty clay, 3 to 6 percent slopes	Marias	No	rise	—	—	—	—
	Farnuf	No	rise	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
	Krem	No	rise	—	—	—	—
	Williams	No	rise	—	—	—	—
	Makoti	No	flat	—	—	—	—
2175:							
Zahl-Williams loams, 6 to 9 percent slopes	Zahl	No	knoll, ridge	—	—	—	—
	Williams	No	knoll, ridge	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
2176:							
Zahl-Williams loams, 15 to 60 percent slopes	Zahl	No	ridge	—	—	—	—
	Williams	No	ridge	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Wabek	No	ridge	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Marias	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
2177:							
Zahl-Williams-Vallers loams, 0 to 60 percent slopes	Zahl	No	ridge	—	—	—	—
	Williams	No	ridge	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
	Hamerly	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Bowbells	No	swale	—	—	—	—
	Wabek	No	ridge	—	—	—	—
	Harriet	Yes	flat	2B3,4	Yes	Yes	No
	Southam	Yes	depression	2B3,3	Yes	No	Yes
2178:							
Farnuf-Alkabo silt loams, 0 to 3 percent slopes	Farnuf	No	flat	—	—	—	—
	Alkabo	No	rise	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Hamerly	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Sakakawea	No	rise	—	—	—	—
	Makoti	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2179:							
Noonan-Niobell loams, 1 to 6 percent slopes	Noonan	No	swale	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Williams	No	rise	—	—	—	—
	Miranda	No	flat	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Heil	Yes	depression	3,2B3	Yes	No	Yes
	Parnell	Yes	depression	2B3,3	Yes	No	Yes
2180:							
Niobell-Noonan-Tonka complex, 0 to 3 percent slopes	Niobell	No	rise	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Miranda	No	flat	—	—	—	—
	Parnell	Yes	depression, moraine	2B3,3	Yes	No	Yes
	Williams	No	rise	—	—	—	—
	Heil	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	rise	—	—	—	—
	Vallers	Yes	flat	2B3	Yes	No	No
2181:							
Miranda-Noonan loams, 0 to 3 percent slopes	Miranda	No	flat	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Hamerly	No	flat	—	—	—	—
	Parnell	Yes	depression	3,2B3	Yes	No	Yes
	Williams	No	rise	—	—	—	—
	Exline	No	flat	—	—	—	—
2182:							
Portal-Lihen fine sandy loams, 0 to 3 percent slopes	Portal	No	flat, terrace	—	—	—	—
	Lihen	No	rise, terrace	—	—	—	—
	Miranda	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Noonan	No	flat	—	—	—	—
	Parshall	No	flat	—	—	—	—
	Williams	No	rise	—	—	—	—
	Bowbells	No	swale	—	—	—	—
2183:							
Lihen-Blanchard loamy fine sands, 1 to 6 percent slopes	Lihen	No	flat, terrace	—	—	—	—
	Blanchard	No	rise, terrace	—	—	—	—
	Dooley	No	terrace	—	—	—	—
	Portal	No	terrace	—	—	—	—
	Zahl	No	rise	—	—	—	—
	Kratka	Yes	depression	2B3	Yes	No	No
	Appam	No	terrace	—	—	—	—
	Hamerly	No	flat	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2184:							
Williams-Zahl complex, 3 to 6 percent slopes	Williams	No	rise	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Tally	No	alluvial fan	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Lehr	No	flat, terrace	—	—	—	—
	Hamerly	No	rise	—	—	—	—
	Niobell	No	swale	—	—	—	—
2185:							
Williams-Zahl-Lihen complex, 6 to 15 percent slopes	Williams	No	knoll, ridge	—	—	—	—
	Lihen	No	knoll	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Parshall	No	flat	—	—	—	—
	Appam	No	knoll	—	—	—	—
	Krem	No	knoll	—	—	—	—
	Seroco	No	knoll	—	—	—	—
	Farnuf	No	alluvial fan	—	—	—	—
2186:							
Lehr-Wabek loams, 1 to 3 percent slopes	Lehr	No	rise, terrace	—	—	—	—
	Wabek	No	rise, terrace	—	—	—	—
	Stady	No	terrace	—	—	—	—
	Appam	No	terrace	—	—	—	—
	Parshall	No	flat	—	—	—	—
	Divide	No	channel	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Zahl	No	rise	—	—	—	—
2187:							
Appam-Wabek complex, 1 to 6 percent slopes	Appam	No	flat, terrace	—	—	—	—
	Wabek	No	rise, terrace	—	—	—	—
	Tally	No	rise	—	—	—	—
	Lihen	No	rise	—	—	—	—
	Lehr	No	rise	—	—	—	—
	Stady	No	rise	—	—	—	—
	Farnuf	No	flat	—	—	—	—
	Marysland	Yes	depression	2B3	Yes	No	No
2188:							
Wabek-Lehr complex, 1 to 6 percent slopes	Wabek	No	rise, terrace	—	—	—	—
	Lehr	No	flat, terrace	—	—	—	—
	Appam	No	flat, terrace	—	—	—	—
	Stady	No	flat	—	—	—	—
	Williams	No	rise	—	—	—	—
	Divide	No	flat	—	—	—	—
	Tonka	Yes	depression	2B3,3	Yes	No	Yes
	Zahl	No	rise	—	—	—	—
2189:							
Wabek-Appam complex, 6 to 35 percent slopes	Wabek	No	knoll, ridge	—	—	—	—
	Appam	No	swale	—	—	—	—
	Stady	No	flat	—	—	—	—
	Lehr	No	rise	—	—	—	—
	Bowbells	No	swale	—	—	—	—
	Divide	No	flat	—	—	—	—
	Williams	No	rise	—	—	—	—

Table 24.-Hydric Soils List--Continued

Map symbol and map unit name	Component	Hydric	Local landform	Hydric soils criteria: Hydric criteria code	Meets saturation criteria	Meets flooding criteria	Meets ponding criteria
2190:							
Williams sandy loam, 1 to 3 percent slopes	Williams	No	rise	—	—	—	—
	Parshall	No	swale	—	—	—	—
	Farnuf	No	flat	—	—	—	—
	Niobell	No	swale	—	—	—	—
	Krem	No	rise	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
	Hamerly	No	rise	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes
2191:							
Towner-Kratka complex, 0 to 3 percent slopes	Towner	No	rise	—	—	—	—
	Kratka	Yes	swale	2B3	Yes	No	No
	Wyard	No	swale	—	—	—	—
	Barnes	No	rise	—	—	—	—
	Swenoda	No	rise	—	—	—	—
	Wyndmere	No	flat	—	—	—	—
2192:							
Kratka-Wyndmere fine sandy loams, 0 to 3 percent slopes	Kratka	Yes	swale	2B3	Yes	No	No
	Wyndmere	No	flat	—	—	—	—
	Swenoda	No	rise	—	—	—	—
	Tiffany	Yes	depression	3,2B3	Yes	No	Yes
	Wyard	No	swale	—	—	—	—
	Buse	No	knoll	—	—	—	—
	Cresbard	No	flat	—	—	—	—
	Towner	No	rise	—	—	—	—
2193:							
Dumps, mine-Ustorthents complex, 0 to 75 percent	Dumps, mine	No	depression	—	—	—	—
	Ustorthents	No	ridge	—	—	—	—
	Parnell	Yes	depression, moraine	3,2B3	Yes	No	Yes
	Harriet	Yes	drainageway, flood plain	2B3	Yes	No	No
	Southam	Yes	depression	2B3,3	Yes	No	Yes
2194:							
Haplustolls-Ustorthents complex, reclaimed, 0 to 6 percent slopes	Haplustolls	No	flat, swale	—	—	—	—
	Ustorthents	No	rise	—	—	—	—
	Williams	No	rise	—	—	—	—
	Noonan	No	swale	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
2195:							
Ustorthents-Haplustolls complex, reclaimed, 6 to 9 percent slopes	Ustorthents	No	knoll	—	—	—	—
	Haplustolls	No	knoll	—	—	—	—
	Williams	No	knoll, ridge	—	—	—	—
	Noonan	No	swale	—	—	—	—
	Zahl	No	knoll, ridge	—	—	—	—
2227:							
Swenoda fine sandy loam, 0 to 6 percent slopes	Swenoda	No	rise	—	—	—	—
	Eckman	No	rise	—	—	—	—
	Towner	No	rise	—	—	—	—
	Arvilla	No	rise	—	—	—	—
	Kratka	Yes	swale	2B3	Yes	No	No
	Cresbard	No	flat	—	—	—	—
	Tonka	Yes	depression	3,2B3	Yes	No	Yes

HYDRIC SOILS CRITERIA CODES AND DEFINITIONS

1. All Histosols except Folists, or

2. Soils in Aquic suborders, great groups, or subgroups, Albolls suborder, Aquisalids, Pachic subgroups, or Cumulic subgroups that are:

   a. Somewhat poorly drained with a water table equal to 0.0 foot (ft) from the surface during the growing season, or

   b. poorly drained or very poorly drained and have either:

      (1) water table equal to 0.0 ft during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 inches (in),

      or for other soils

      (2) water table at less than or equal to 0.5 ft from the surface during the growing season if permeability is equal to or greater than 6.0 inches/hour in all layers within 20 in, or

      (3) water table at less than or equal to 1.0 ft from the surface during the growing season if permeability is less than 6.0 inches/hour in any layer within 20 in, or

3. Soils that are frequently ponded for long duration or very long duration during the growing season, or

4. Soils that are frequently flooded for long duration or very long duration during the growing season.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Ablation till. Loose, permeable till deposited during the final downwasting of glacial ice. Lenses of crudely sorted sand and gravel are common.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep, rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvial fan. The fanlike deposit of a stream where it issues from a gorge upon a plain or of a tributary stream near or at its junction with its main stream.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Alpha, alpha-dipyridyl. A dye that when dissolved in 1N ammonium acetate is used to detect the presence of reduced iron (Fe II) in the soil. A positive reaction indicates a type of redoximorphic feature.

Animal-unit month (AUM). The amount of forage required by one mature cow weighing approximately 1,000 pounds, with or without a calf, for 1 month.

Aquic conditions. Current soil wetness characterized by saturation, reduction, and redoximorphic features.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Aspect. The direction in which a slope faces.

Association, soil. A group of soils or miscellaneous areas geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Atterberg Limits. A general term that encompasses liquid limit, plastic limit, and shrinkage limit. It is used as an integral part of several engineering classification systems.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	More than 12

Badland. Moderately steep to very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface. It may be either **lithic** (digging with a hand spade impractical) or **paralithic** (dug with difficulty with a spade).

Blowout. A shallow depression from which all or most of the soil material has been removed by the wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Breaks. The steep and very steep broken land at the border of an upland summit that is dissected by ravines.

Brush management. Use of mechanical, chemical, or biological methods to make conditions favorable for reseeding or to reduce or eliminate competition from woody vegetation and thus allow understory grasses and forbs to recover. Brush management increases forage production and thus reduces the hazard of erosion. It can improve the habitat for some species of wildlife.

Butte. An isolated small mountain or hill with steep or precipitous sides and a top variously flat, rounded, or pointed that may be a residual mass isolated by erosion.

$CaCO_3$ Equivalent. The quantity of carbonate (CO_3) in the soil expressed as $CaCO_3$. This material is important to the fertility, erosion, available water holding capacity, and genesis of a soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or “chain,” of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil material. Soil material that is, by volume, 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches (15 centimeters) along the longest axis. A single piece is called a channer.

Chemical treatment. Control of unwanted vegetation through the use of chemicals.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay depletions. Low-chroma zones having a low content of iron, manganese, and clay because of the chemical reduction of iron and manganese and the removal of iron, manganese, and clay. A type of redoximorphic depletion.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax plant community. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse textured soil. Sand or loamy sand.

Cobble (or cobblestone). A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

Cobbly soil material. Material that is 15 to 35 percent, by volume, rounded or partially rounded rock fragments 3 to 10 inches (7.6 to 25 centimeters) in diameter. Very cobbly soil material has 35 to 60 percent of these rock fragments, and extremely cobbly soil material has more than 60 percent.

Collapsed lake plain. A previously nearly level surface marking the floor of an extinct lake, filled in by well-sorted deposits from inflowing streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Collapsed outwash plain. A previously broad, flat, or gently sloping alluvial sheet of outwash deposited by meltwater streams and underlain by glacial ice, now having the surface configuration of the underlying topography as a result of melting of the glacial ice.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil or miscellaneous areas in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas.

Concretions. Cemented bodies with crude internal symmetry organized around a point, a line, or a plane. They typically take the form of concentric layers visible to the naked eye. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up concretions. If formed in place, concretions of iron oxide or manganese oxide are generally considered a type of redoximorphic concentration.

Conglomerate. A coarse grained, clastic rock composed of rounded or subangular rock fragments more than 2 millimeters in diameter. It commonly has a matrix of sand and finer textured material. Conglomerate is the consolidated equivalent of gravel.

Conservation cropping system. Growing crops in combination with needed cultural and management practices. In a good conservation cropping system, the soil-improving crops and practices more than offset the effects of the soil-depleting crops and practices. Cropping systems are needed on all tilled soils. Soil-improving practices in a conservation cropping system include the use of rotations that contain grasses and legumes and the return of crop residue to the soil. Other practices include the use of green manure crops of grasses and legumes, proper tillage, adequate fertilization, and weed and pest control.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

Loose ..... noncoherent when dry or moist; does not hold together in a mass.

Friable ..... when moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm .... when moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic .... when wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

Sticky ...... when wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard ... when dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft .... when dry, breaks into powder or individual grains under very slight pressure.

Cemented .... hard, little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Contrasting soils (Dissimilar soils). Soils that do not share limits of diagnostic criteria, behave and perform in a similar manner, or have similar conservation needs or management requirements for the major land uses in the survey area.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosion. Soil-induced electrochemical or chemical action that dissolves or weakens concrete or uncoated steel.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cropping system. Growing crops according to a planned system of rotation and management practices.

Crop residue management. Returning crop residue to the soil, which helps to maintain soil structure, organic matter content, and fertility and helps to control erosion.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Delta. A body of alluvium having a surface that is nearly flat and fan shaped; deposited at or near the mouth of a river or stream where it enters a body of relatively quiet water, generally a sea or lake.

Dense layer (in tables). A very firm, massive layer that has a bulk density of more than 1.8 grams per

cubic centimeter. Such a layer affects the ease of digging and can affect filling and compacting.

Depth, soil. Generally, the thickness of the soil over bedrock. Very deep soils are more than 60 inches deep over bedrock; deep soils, 40 to 60 inches; moderately deep, 20 to 40 inches; shallow, 10 to 20 inches; and very shallow, less than 10 inches.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Divided-slope farming. A form of field stripcropping in which crops are grown in a systematic arrangement of two strips, or bands, across the slope to reduce the hazard of water erosion. One strip is in a close-growing crop that provides protection from erosion, and the other strip is in a crop that provides less protection from erosion. This practice is used where slopes are not long enough to permit a full stripcropping pattern to be used.

Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized:

Excessively drained . .... these soils have very high and high hydraulic conductivity and a low water-holding capacity. They are not suited to crop production unless irrigated.

Somewhat excessively drained .... these soils have high hydraulic conductivity and a low water-holding capacity. Without irrigation, only a narrow range of crops can be grown and yields are low.

Well drained .... these soils have an intermediate water-holding capacity. They retain optimum amounts of moisture, but they are not wet close enough to the surface or long enough during the growing season to adversely affect yields.

Moderately well drained ... these soils are wet close enough to the surface or long enough that planting or harvesting operations or yields of some field crops are adversely affected unless a drainage system is installed. Moderately well drained soils commonly have a layer with low hydraulic conductivity, a wet layer relatively high in the profile, additions of water by seepage, or some combination of these.

Somewhat poorly drained.. .... these soils are wet close enough to the surface or long enough that planting or harvesting operations or crop growth is markedly restricted unless a drainage system is installed. Somewhat poorly drained soils commonly have a layer with low hydraulic conductivity, a wet layer high in the profile, additions of water through seepage, or a combination of these.

Poorly drained .. .. these soils commonly are so wet at or near the surface during a considerable part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these.

Very poorly drained .... these soils are wet to the surface most of the time. The wetness prevents the growth of important crops (except rice) unless a drainage system is installed.

Drainage, surface. Runoff, or surface flow of water, from an area.

Drainageway. An area of ground at a lower elevation than the surrounding ground and in which water collects and is drained to a closed depression or lake or to a drainageway at a lower elevation. A drainageway may or may not have distinctly incised channels at its upper reaches or throughout its course.

Draw. A small stream valley that generally is more open and has broader bottom land than a ravine or gulch.

Drift. A general term applied to all material transported by a glacier and deposited directly from the ice or by running water coming from the ice. Drift includes unstratified material (till) that forms moraines, and stratified glaciofluvial deposits that form outwash plains, eskers, kames, varves, and glaciolacustrine sediments. The term is generally applied to Pleistocene glacial deposits in areas that no longer contain glaciers.

Drumlin. A low, smooth, elongated oval hill, mound, or ridge of compact glacial till. The longer axis is parallel to the path of the glacier and commonly has a blunt nose pointing in the direction from which the ice approached.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Endosaturation. A type of saturation of the soil in which all horizons between the upper boundary of saturation and a depth of 2 meters are saturated.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Ephemeral stream. A stream, or reach of a stream, that flows only in direct response to precipitation. It receives no long-continued supply from melting snow or other source, and its channel is above the water table at all times.

Episaturation. A type of saturation indicating a perched water table in a soil in which saturated layers are underlain by one or more unsaturated layers within 2 meters of the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, such as a fire, that exposes the surface.

Escarpment. A relatively continuous and steep slope or cliff breaking the general continuity of more gently sloping land surfaces and resulting from erosion or faulting. Synonym: scarp.

Esker. A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Excess lime (in tables). Excess carbonates in the soil that restrict the growth of some plants.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Excess sodium (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess sulfur (in tables). Excessive amount of sulfur in the soil. The sulfur causes extreme acidity if the soil is drained, and the growth of most plants is restricted.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grain is grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fan terrace. A relict alluvial fan, no longer a site of active deposition, incised by younger and lower alluvial surfaces.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

Fill slope. A sloping surface consisting of excavated soil material from a road cut. It commonly is on the downhill side of the road.

Fine textured soil. Sandy clay, silty clay, or clay.

Flaggy soil material. Material that is, by volume, 15 to 35 percent flagstones. Very flaggy soil material has 35 to 60 percent flagstones, and extremely flaggy soil material has more than 60 percent flagstones.

Flagstone. A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist 6 to 15 inches (15 to 38 centimeters) long.

Flooding. The temporary covering of the soil surface by flowing water from any source.

Flooding frequency classes:

None .... 0 percent chance of flooding in any year.

Rare.. ...... .0 to 5 percent chance of flooding in any year.

Occasional ..... 5 to 50 percent chance of flooding in any year.

Frequent.....more than 50 percent chance of flooding in any year.

Flooding duration classes:

Extremely brief .... 0.1 to 4.0 hours

Very brief .... 4 to 48 hours

Brief .... 2 to 7 days

Long .... 7 to 30 days

Very long .... more than 30 days

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Fluvial. Of or pertaining to rivers; produced by river action, as a fluvial plain.

Foothill. A steeply sloping upland that has relief of as much as 1,000 feet (300 meters) and fringes a mountain range or high-plateau escarpment.
Foot slope. The bottom of a slope or the lower part of any elevated landform.
Forb. Any herbaceous plant not a grass or a sedge.
Forest cover. All trees and other woody plants (underbrush) covering the ground in a forest.
Forest type. A stand of trees similar in composition and development because of given physical and biological factors by which it may be differentiated from other stands.
Fragile (in tables). A soil that is easily damaged by use or disturbance.
Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.
Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.
Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.
Gilgai. Commonly, a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of clayey soils that shrink and swell considerably with changes in moisture content.
Glacial drift. Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.
Glacial outwash. Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.
Glacial till. Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.
Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.
Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.
Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors.
Graded stripcropping. Growing crops in strips that grade toward a protected waterway.
Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.
Gravel. Rounded or angular fragments of rock as much as 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.
Gravelly soil material. Material that is 15 to 35 percent, by volume, rounded or angular rock fragments, not prominently flattened, as much as 3 inches (7.6 centimeters) in diameter.
Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.
Ground water. Water filling all the unblocked pores of the material below the water table.
Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage. A gullied map unit is one that has numerous gullies.
Hard bedrock. Bedrock that cannot be excavated except by blasting or by the use of special equipment that is not commonly used in construction.
Hardpan. A hardened or cemented soil horizon or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substance.
Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric material and the more decomposed sapric material.
High-residue crops. Such crops as small grain and corn used for grain. If properly managed, residue from these crops can be used to control erosion until the next crop in the rotation is established. These crops return large amounts of organic matter to the soil.
Hill. A natural elevation of the land surface, rising as much as 1,000 feet above surrounding lowlands, commonly of limited summit area and having a well defined outline; hillsides generally have slopes

of more than 15 percent. The distinction between a hill and a mountain is arbitrary and is dependent on local usage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the “Soil Survey Manual.” The major horizons of mineral soil are as follows:

O horizon......an organic layer of fresh and decaying plant residue.

A horizon......the mineral horizon at or near the surface in which an accumulation of humidified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

E horizon......the mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon......the mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon......the mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying soil material. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon......Soft, consolidated bedrock beneath the soil.

R layer......Consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon, but it can be directly below an A or a B horizon.

Hummock. A slight mound or rise of ground above a level surface; generally of equidimensional shape and not ridge-like.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydric soil. Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions for the upper part.

Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff.

Igneous rock. Rock formed by solidification from a molten or partially molten state. Major varieties include plutonic and volcanic rock. Examples are andesite, basalt, and granite.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intermittent stream. A stream, or reach of a stream, that flows for prolonged periods only when it receives ground-water discharge or long, continued contributions from melting snow or other surface and shallow subsurface sources.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, plants invade following disturbance of the surface.

Iron depletions. Low-chroma zones having a low content of iron and manganese oxide because of chemical reduction and removal, but having a clay content similar to that of the adjacent matrix. A type of redoximorphic depletion.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are:

Basin .... Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Border .... Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Controlled flooding .... Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation .... Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle). .... Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow .... Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler ..... Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation ...... Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding .... Water, released at high points, is allowed to flow onto an area without controlled distribution.

K Factor. Soil erodibility factor in the Universal Soil Loss Equation.

Kame. An irregular, short ridge or hill of stratified glacial drift.

Knoll. A small, low, rounded hill rising above adjacent landforms.

Ksat. See saturated hydraulic conductivity.

Lacustrine deposit. Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Lake plain. A surface marking the floor of an extinct lake, filled in by well sorted, stratified sediments.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Large stones (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Lime. A soil material that consists of precipitated calcium or magnesium carbonate.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low-residue crops. Such crops as corn used for silage, peas, beans, and potatoes. Residue from these crops is not adequate to control erosion until the next crop in the rotation is established. These crops return little organic matter to the soil.

Low strength. The soil is not strong enough to support loads.

Masses. Concentrations of substances in the soil matrix that do not have a clearly defined boundary with the surrounding soil material and cannot be removed as a discrete unit. Common compounds making up masses are calcium carbonate, gypsum or other soluble salts, iron oxide, and manganese oxide. Masses consisting of iron oxide or manganese oxide generally are considered a type of redoximorphic concentration.

Mechanical treatment. Use of mechanical equipment for seeding, brush management, and other management practices.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, or fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, or silty clay loam.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Moraine. An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Descriptive terms are as follows: abundance - few, common, and many; size - fine, medium, and coarse; and contrast - faint, distinct, and prominent. The size measurements are of the diameter along the greatest dimension. Fine indicates less than 5 millimeters (about 0.2 inch); medium, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and coarse, more than 15 millimeters (about 0.6 inch).

Mountain. A natural elevation of the land surface, rising more than 1,000 feet above surrounding lowlands, commonly of restricted summit area (relative to a plateau) and generally having steep sides. A mountain can occur as a single, isolated mass or in a group forming a chain or range.

Muck. Dark, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Mudstone. A blocky or massive, fine-grained sedimentary rock that consists of a mixture of clay, silt, and sand particles, the proportion of which vary from place to place.

Munsell notation. A designation of color by degrees of three simple variables - hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

Natric horizon. A special kind of argillic horizon that contains enough exchangeable sodium to have an adverse effect on the physical condition of the subsoil.

Neutral soil. A soil having a pH value of 6.6 to 7.3. (See Reaction, soil.)

Nodules. Cemented bodies lacking visible internal structure. Calcium carbonate, iron oxide, and manganese oxide are common compounds making up nodules. If formed in place, nodules of iron oxide or manganese oxide are considered types of redoximorphic concentrations.

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition. The content of organic matter in the surface layer is described as follows:

Very low	less than 0.5 percent
Low	0.5 to 1.0 percent
Moderately low	1.0 to 2.0 percent
Moderate	2.0 to 4.0 percent
High	4.0 to 8.0 percent
Very high	more than 8.0 percent

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it generally is low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, hardpan, fragipan, claypan, plowpan, and traffic pan.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affects the specified use.

Permeability. See saturated hydraulic conductivity (Ksat).

Phase, soil. A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and flooding.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plateau. An extensive upland mass with relatively flat summit area that is considerably elevated (more than 100 meters) above adjacent lowlands and separated from them on one or more sides by escarpments.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Very brief	less than 2 days
Brief	2 to 7 days
Long	7 to 30 days
Very long	more than 30 days

Poor filter (in tables). Because of rapid or very rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets (in tables). Refers to areas where surface or subsurface drainage outlets are difficult or expensive to install.

Porcelanite (scoria). Shale and clay that are fused as a result of their proximity to a burning coal vein.

Potential native plant community. See Climax plant community.

Potential rooting depth (effective rooting depth). Depth to which roots could penetrate if the content of moisture in the soil were adequate. The soil has no properties restricting the penetration of roots to this depth.

Prescribed burning. Deliberately burning an area for specific management purposes, under the appropriate conditions of weather and soil moisture and at the proper time of day.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. Grazing at an intensity that maintains enough cover to protect the soil and maintain or improve the quantity and quality of the desirable vegetation. This practice increases the vigor and reproduction capacity of the key plants and promotes the accumulation of litter and mulch necessary to conserve soil and water.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Ultra acid	less than 3.5
Extremely acid	3.5 to 4.4
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Moderately acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Slightly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Red beds. Sedimentary strata that are mainly red and are made up largely of sandstone and shale.

Redoximorphic concentrations. Nodules, concretions, soft masses, pore linings, and other features resulting from the accumulation of iron or manganese oxide. An indication of chemical reduction and oxidation resulting from saturation.

Redoximorphic depletions. Low-chroma (2 or less) zones from which iron and manganese oxide or a combination of iron and manganese oxide and clay has been removed. These zones are indications of the chemical reduction of iron resulting from saturation.

Redoximorphic features. Redoximorphic concentrations, redoximorphic depletions, reduced matrices, a positive reaction to alpha, alpha-dipyridyl, and other features indicating the chemical reduction and oxidation of iron and manganese compounds resulting from saturation.

Reduced matrix. A soil matrix that has low chroma in situ because of chemically reduced iron (Fe II). The chemical reduction results from nearly continuous wetness. The matrix undergoes a change in hue or chroma within 30 minutes after

exposure to air as the iron is oxidized (Fe III). A type of redoximorphic feature.

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Retrogression. The process by which rangeland vegetation changes significantly from the natural potential plant community. syn., range deterioration, site deterioration.

Revised Universal Soil Loss Equation (RUSLE). An erosion model designed to predict the long term average soil loss carried by runoff from specific field slopes in specified cropping and management systems.

Rill. A steep-sided channel resulting from accelerated erosion. A rill generally is a few inches deep and not wide enough to be an obstacle to farm machinery.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rock outcrop. Exposures of bare bedrock other than lava flows and rock-lined pits. Most rock outcrops are hard rock.

Root shearing. The cutting, tearing, and disruption of plant roots by the hooves of animals during grazing when the soil is wet and soft.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline seep. Areas of nonirrigated soils with restricted drainage, where salinity has recently developed.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Saline-sodic soil. A soil containing a combination of soluble salts and exchangeable sodium sufficient to interfere with the growth of plants.

Salty water (in tables). Water that is too salty for consumption by livestock.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-sized particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saturation. Wetness characterized by zero or positive pressure of the soil water. Under conditions of saturation, the water will flow from the soil matrix into an unlined auger hole.

Saturated hydraulic conductivity (Ksat). The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality. Terms describing saturated hydraulic conductivity, measured in inches per hour, are as follows:

Extremely slow	0.0 to 0.01 inch
Very slow	0.01 to 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Scarification. The act of abrading, scratching, loosening, crushing, or modifying the surface to increase water absorption or to provide a more tillable soil.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shoulder slope. The uppermost inclined surface at the top of a hillside. It is the transition zone from the back slope to the summit of a hill or mountain. The surface is dominantly convex in profile and erosional in origin.

Shrink-swell (in tables). The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil generally is silty or clayey, is slippery when wet, and is low in productivity.

Slippage (in tables). Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance. In this survey, classes for simple slopes are as follows:

Level	0 to 1 percent
Level and nearly level	0 to 3 percent
Nearly level	1 to 3 percent
Gently sloping or undulating	3 to 6 percent
Moderately sloping or gently rolling	6 to 9 percent
Strongly sloping or rolling	9 to 15 percent
Moderately steep or hilly	15 to 25 percent
Steep	25 to 35 percent
Very steep	More than 35 percent

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium adsorption ratio (SAR) of a saturation extract, or the ratio of the Na concentration divided by the square root of one-half of the Ca + Mg concentration. The degrees of sodicity and their respective ratios are:

Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Soft bedrock. Bedrock that can be excavated with trenching machines, backhoes, small rippers, and other equipment commonly used in construction.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil depth class. The distance from the top of the soil to the underlying bedrock. The distance, in inches, is expressed as:

Very shallow	less than 10 inches
Shallow	10 to 20 inches
Moderately deep	20 to 40 inches
Deep	40 to 60 inches
Very deep	greater than 60 inches

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and

sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the material below the solum. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands that provide vegetative barriers to wind erosion and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are - platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), blocky (angular or subangular), and granular. Structureless soils are either single grained (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind erosion and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Tilling a soil below normal plow depth, ordinarily to shatter a hardpan or claypan.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the E horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the “plow layer,” or the “Ap horizon.”

Surface soil. The A, E, AB, and EB horizons, considered collectively. It includes all subdivisions of these horizons.

Talus. Fragments of rock and other soil material accumulated by gravity at the foot of cliffs or steep slopes.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior. Soils are recognized as taxadjuncts only when one or more of their characteristics are slightly outside the range defined for the family of the series for which the soils are named.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet. A terrace in a field generally is built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are - sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying “coarse,” “fine,” or “very fine.”

Thin layer (in tables). Otherwise suitable soil material that is too thin for the specified use.

Till plain. An extensive area of nearly level to undulating soils underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toeslope. The lower gentle slope of a hillside. The lowest part of a foot slope.

Too arid (in tables). The soil is dry most of the time and vegetation is difficult to establish.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Toxicity (in tables). Excessive amount of toxic substances, such as sodium or sulfur, that severely hinder establishment of vegetation or severely restrict plant growth.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, in soils in extremely small amounts. They are essential to plant growth.

Universal Soil Loss Equation (USLE). An equation used to design water erosion control systems: **A—RKLSPC** where **A** is average annual soil loss in tons per acre per year; **R** is the rainfall factor; **K** is the soil erodibility factor; **L** is the length of slope; **S** is the percent slope; **P** is the conservation practice factor; and **C** is the cropping and management factor.

Unstable fill (in tables). Risk of caving or sloughing on banks of fill material.

Upland. Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley. An elongated depressional area primarily developed by stream action.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer or a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Very deep soil. A soil that is more than 60 inches deep over bedrock or to other material that restricts the penetration of plant rows.

Very shallow soil. A soil that is less than 10 inches deep over bedrock or to other material that restricts the penetration of plant roots.

Water table. The upper surface of groundwater or that level below the surface where the soil is saturated with water. For soil survey purposes, the depth the water table is observed is within 60 inches from the surface.

Apparent .... Level at which water stands in a freshly dug, unlined borehole after it has adequate time for adjustments in the surrounding soil.

Perched .... A saturated soil zone above an unsaturated layer in the soil.

Artesian .... A water table under hydrostatic head beneath an impermeable layer.

Seasonal .... A water table within 60 inches of the surface during the growing season.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Windsculptured. A land surface of which its form has been changed by action of the wind.

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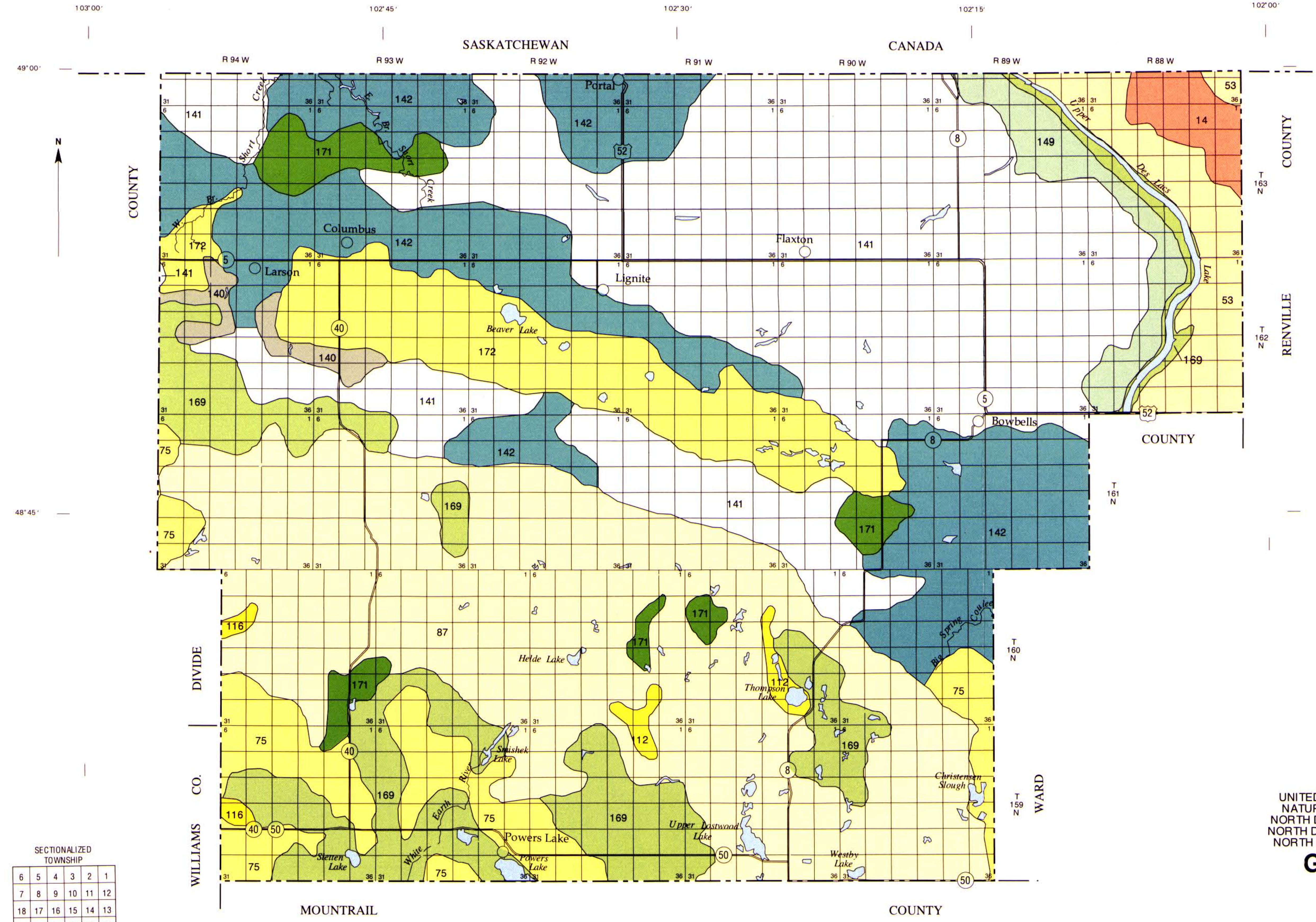


6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SOIL LEGEND*

14	Swenoda-Barnes-Hamerly Association, nearly level and undulating
53	Barnes-Cresbard Association, level to undulating
75	Williams-Zahl-Bowbells Association, level to gently rolling
87	Zahl-Williams-Parnell Association, level to steep
112	Wabek-Appam-Lehr Association, level to hilly
116	Stady-Lehr-Arnegard Association, level to gently rolling
140	Dumps, mine-Ustorthents Association, level to very steep
141	Williams-Niobell-Noonan Association, nearly level and undulating
142	Noonan-Niobell Association, nearly level and undulating
149	Dooley-Parshall Association, level to rolling
169	Zahl-Williams Association, undulating to very steep
171	Farnuf-Marias-Alkabo Association, level to gently rolling
172	Harriet-Miranda-Stirum Association, level and nearly level
	Water

*The units on this legend are described in the text under the heading "General Soil Map Units."

Compiled 2000

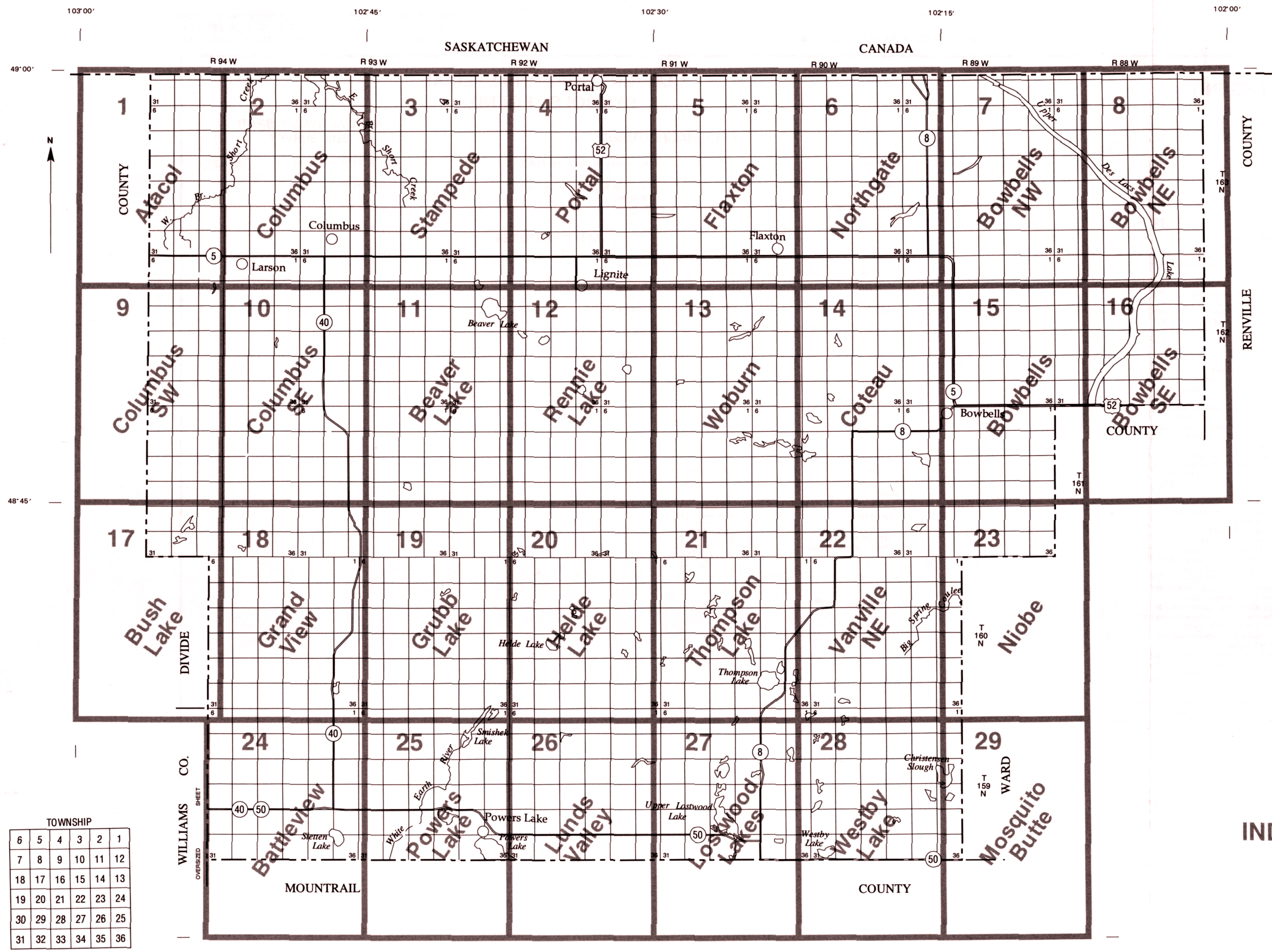
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION
NORTH DAKOTA STATE SOIL CONSERVATION COMMITTEE
NORTH DAKOTA COOPERATIVE EXTENSION SERVICE

GENERAL SOIL MAP
BURKE COUNTY, NORTH DAKOTA

Scale 1:250000

4 0 4
MILES

8 0 8
KILOMETERS



6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

BURKE COUNTY, NORTH DAKOTA

Scale 1:250000

MILES

KILOMETERS

SOIL LEGEND

SYMBOL	NAME
110	Barnes loam, 0 to 3 percent slopes
111	Barnes loam, 3 to 6 percent slopes
120	Barnes-Buse loams, 6 to 9 percent slopes
470	Cresbard-Barnes loams, 0 to 3 percent slopes
674	Farnuf loam, 0 to 3 percent slopes
676	Farnuf-Sakakawea loams, 3 to 6 percent slopes
882	Hamerly Tonka complex, 0 to 3 percent slopes
975	Heil silt loam, 0 to 1 percent slopes
1267	Marysland loam, 0 to 1 percent slopes
1427	Parnell silty clay loam, 0 to 1 percent slopes
1439	Parshall fine sandy loam, 0 to 6 percent slopes
1466	Pits, sand and gravel
1709	Southam silt loam, 0 to 1 percent slopes
1739	Straw loam, 0 to 3 percent slopes
1835	Tonka silt loam, 0 to 1 percent slopes
1871	Vallers loam, saline, 0 to 1 percent slopes
1883	Vallers-Parnell complex, 0 to 1 percent slopes
1978	Water
2014	Williams-Bowbells loams, 0 to 3 percent slopes
2015	Williams-Bowbells loams, 3 to 6 percent slopes
2023	Williams-Niobell loams, 0 to 3 percent slopes
2024	Williams-Niobell loams, 3 to 6 percent slopes
2031	Williams-Zahl loams, 3 to 6 percent slopes
2081	Zahl-Williams loams, 9 to 15 percent slopes
2130	Williams-Zahl-Parnell complex, 0 to 9 percent slopes
2131	Zahl-Williams-Parnell complex, 0 to 35 percent slopes
2169	Harriet, Regan, and Stirum soils, 0 to 1 percent slopes
2170	Divide loam, 0 to 3 percent slopes
2171	Sakakawea-Farnuf loams, 6 to 9 percent slopes
2172	Sakakawea-Farnuf loams, 9 to 25 percent slopes
2173	Marias silty clay, 0 to 3 percent slopes
2174	Marias silty clay, 3 to 6 percent slopes
2175	Zahl-Williams loams, 6 to 9 percent slopes
2176	Zahl-Williams loams, 15 to 60 percent slopes
2177	Zahl-Williams-Vallers loams, 0 to 60 percent slopes
2178	Farnuf-Alkabo silt loams, 0 to 3 percent slopes
2179	Noonan-Niobell loams, 1 to 6 percent slopes
2180	Niobell-Noonan-Tonka complex, 0 to 3 percent slopes
2181	Miranda-Noonan loams, 0 to 3 percent slopes
2182	Portal-Lihen fine sandy loams, 0 to 3 percent slopes
2183	Lihen-Blanchard loamy fine sands, 1 to 6 percent slopes
2184	Williams-Zahl complex, 3 to 6 percent slopes
2185	Williams-Zahl-Lihen complex, 6 to 15 percent slopes
2186	Lehr-Wabek loams, 1 to 3 percent slopes
2187	Appam-Wabek complex, 1 to 6 percent slopes
2188	Wabek-Lehr complex, 1 to 6 percent slopes
2189	Wabek-Appam complex, 6 to 35 percent slopes
2190	Williams sandy loam, 1 to 3 percent slopes
2191	Towner-Kratka complex, 0 to 3 percent slopes
2192	Kratka-Wyndmere fine sandy loams, 0 to 3 percent slopes
2193	Dumps, mine-Ustorthents complex, 0 to 75 percent slopes
2194	Haplustolls-Ustorthents complex, reclaimed, 0 to 6 percent slopes
2195	Ustorthents-Haplustolls complex, reclaimed, 6 to 9 percent slopes
2227	Swenoda fine sandy loam, 0 to 6 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state, or province
- County or parish
- Field sheet matchline and neatline

AD HOC BOUNDARY
(label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK
1 890 000 FEET

LAND DIVISION CORNER
(sections and land grants)

ROADS

- County, farm or ranch

ROAD EMBLEM & DESIGNATIONS

- Federal
- State

RAILROAD

DAMS

- Large (to scale)
- Medium or Small (Named where applicable)

PITS

- Gravel pit (< 5 acres)

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban area) (occupied)
- Church

WATER FEATURES

DRAINAGE

- Intermittent
- Drainage end

LAKES, PONDS AND RESERVOIRS

- Perennial

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS 1805 2031

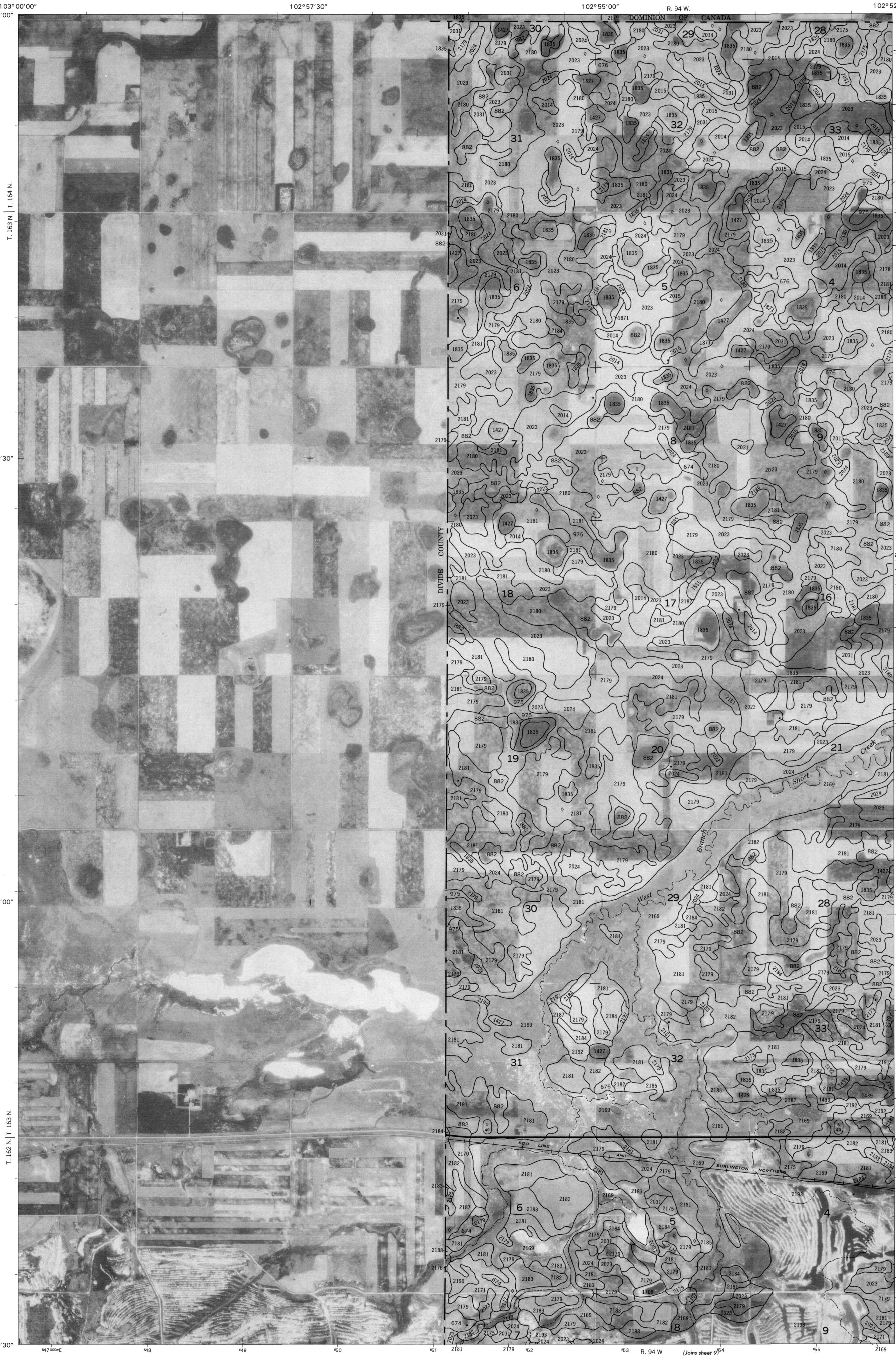
DEPRESSION OR SINK

MISCELLANEOUS

- Saline spot
- Mine sink

103° 00'00" | 102° 57'30" | 102° 55'00" | 102° 52'30"

49° 00'00"



48° 57'30"

48° 55'00"

48° 52'30"

This soil survey was compiled by the U.S. Department of Agriculture, Natural Resources Conservation Service, formerly Soil Conservation Service, and cooperating agencies. Base maps are orthophotographs prepared by the U.S. Department of Interior, Geological Survey, from 1984 aerial photography. Soils data were obtained from SSURGO.

North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS 1 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000

MILES 1 0 1

1	2	3
4		5
6	7	8

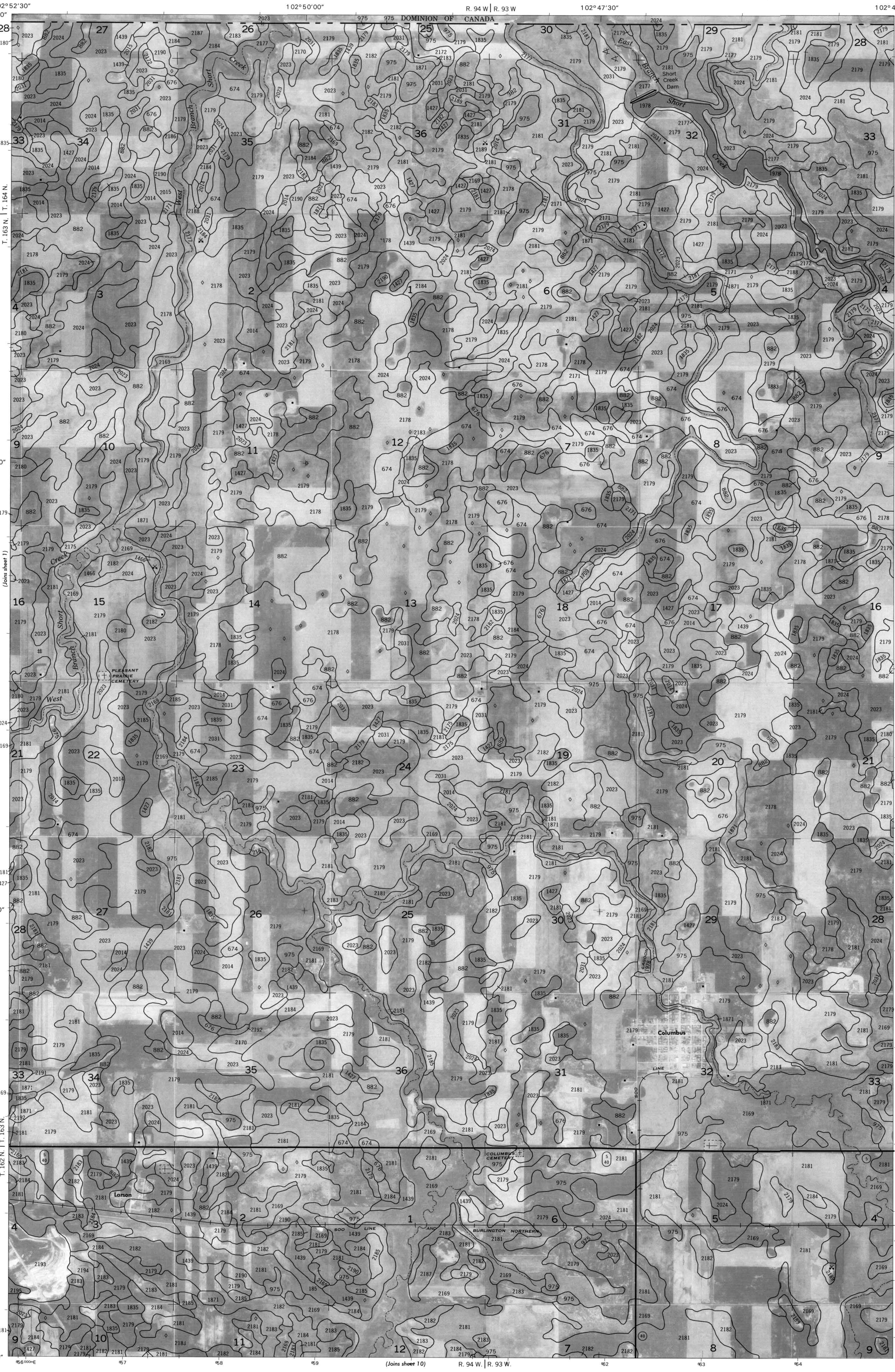
1
2
3
4 NOONAN
5 COLUMBUS
6 NOONAN SE
7 COLUMBUS SW
8 COLUMBUS SE

INDEX TO ADJOINING 7.5 MAPS

ATACOL, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 1 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
COLUMBUS QUADRANGLE
SHEET NUMBER 2 OF 29



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North American Datum of 1927 (NAD27), Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

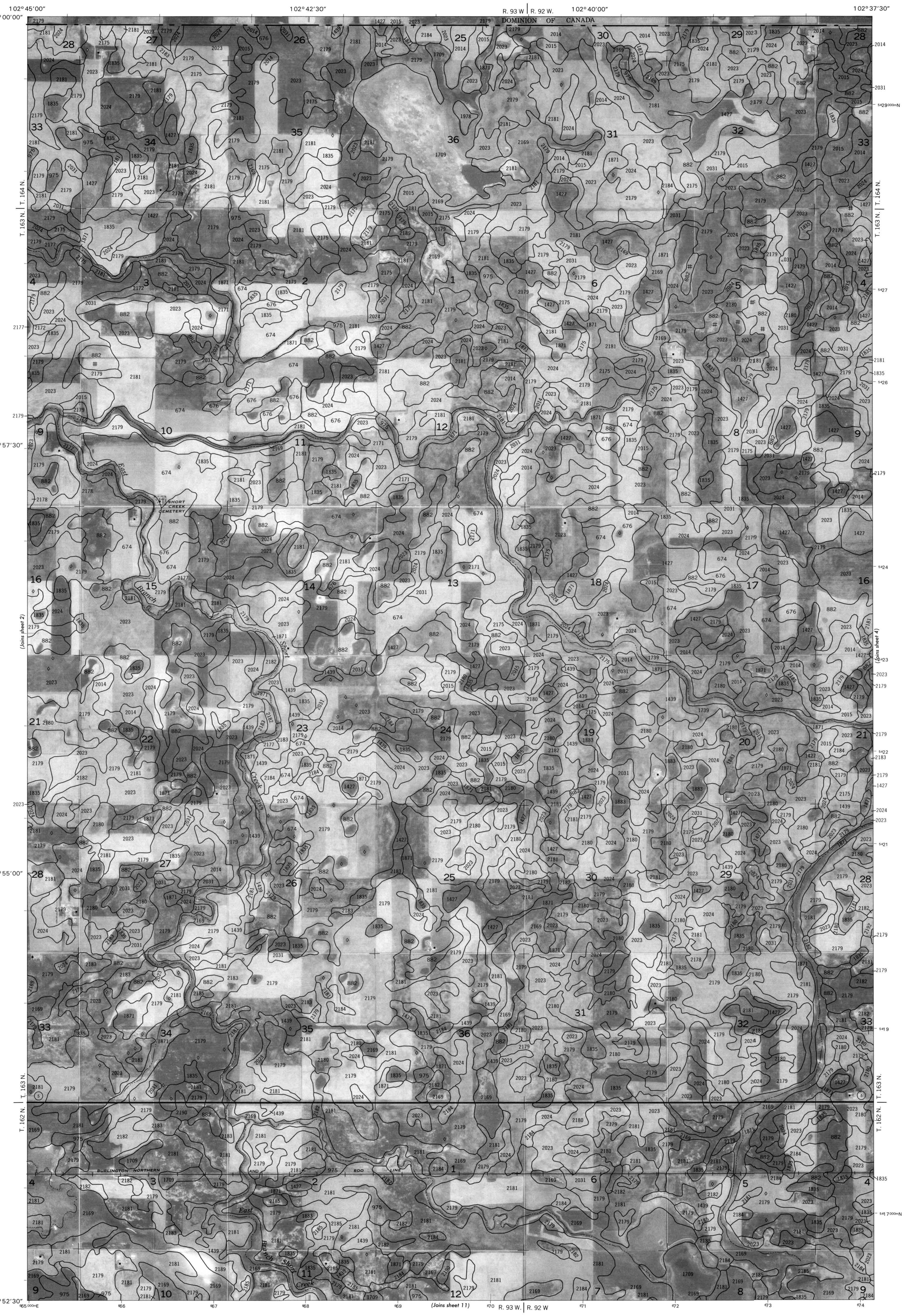
MILES

1	2	3
4		5
6	7	8

1
2
3
4 ATCOAL
5 STAMPEDE
6 COLUMBUS SW
7 COLUMBUS SE
8 BEAVER LAKE

INDEX TO ADJOINING 7.5 MAPS

COLUMBUS, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 2 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

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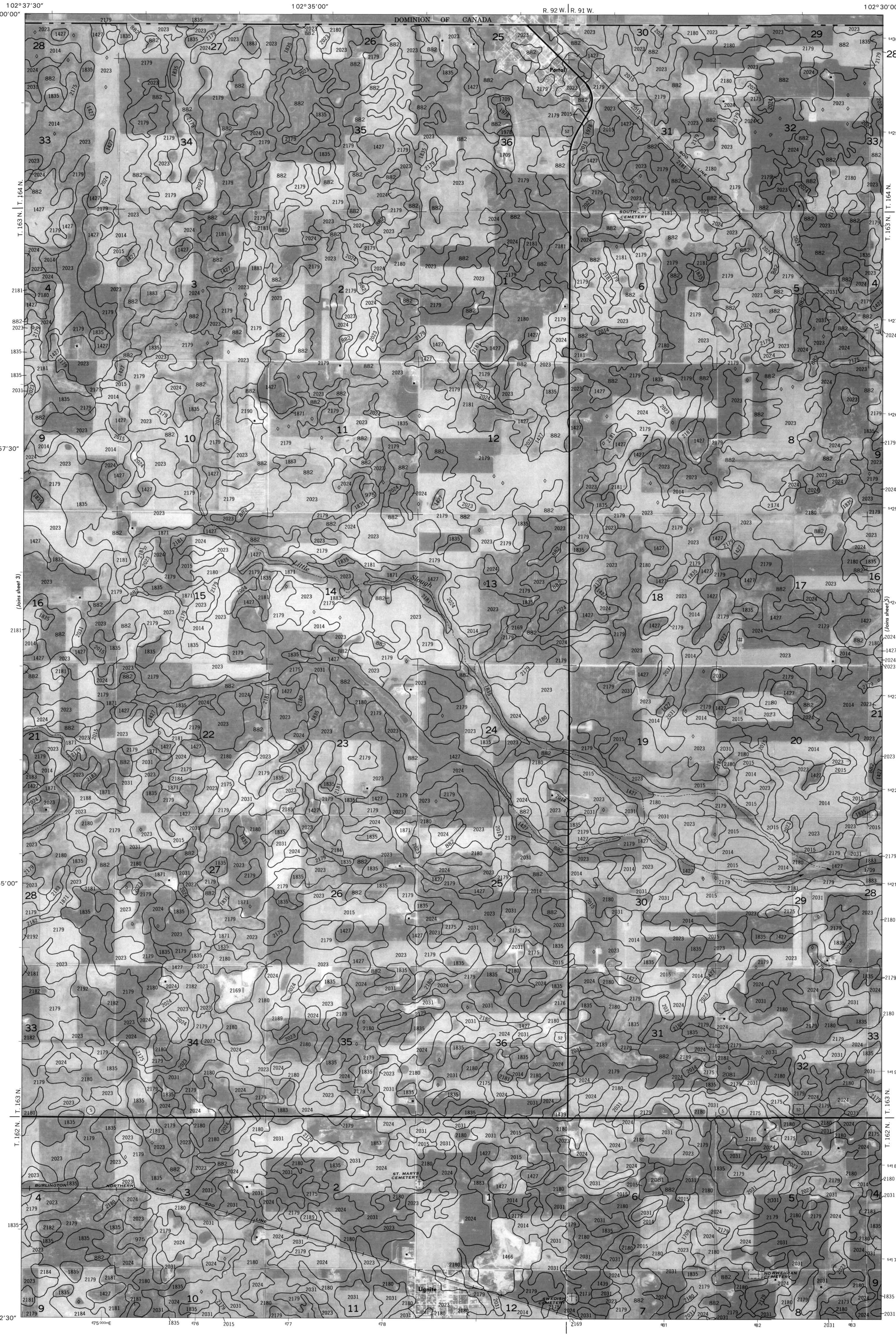
1
2
3
4 COLUMBUS
5 PORTAL
6 COLUMBUS SE
7 BEAVER LAKE
8 RENNIE LAKE

STAMPEDE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 3 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
PORTAL QUADRANGLE
SHEET NUMBER 4 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

BURKE COUNTY, NORTH DAKOTA NO. 4

1	2	3
4		5
6	7	8

1
2
3
4 STAMPEDE
5 FLAXTON
6 BEAVER LAKE
7 RENNIE LAKE
8 WOBURN

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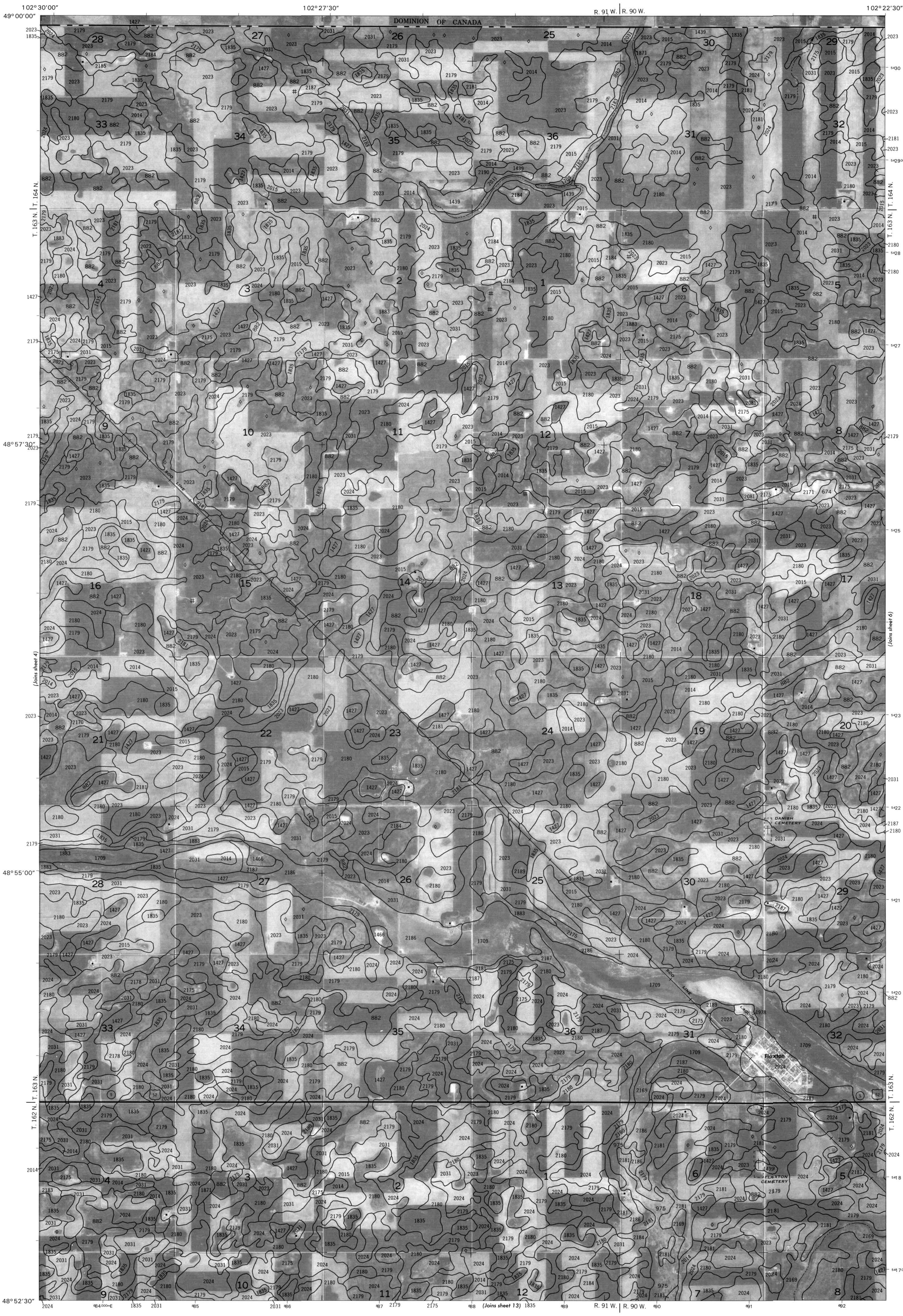
PORTAL, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 4 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
FLAXTON QUADRANGLE
SHEET NUMBER 5 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid
1000-meter ticks: Universal Transverse Mercator, zone 13.
Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS 1 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000

MILES 1 0 1

1	2	3
4		5
6	7	8

1
2
3
4 PORTAL
5 NORTHGATE
6 RENNIE LAKE
7 WOBURN
8 COTEAU

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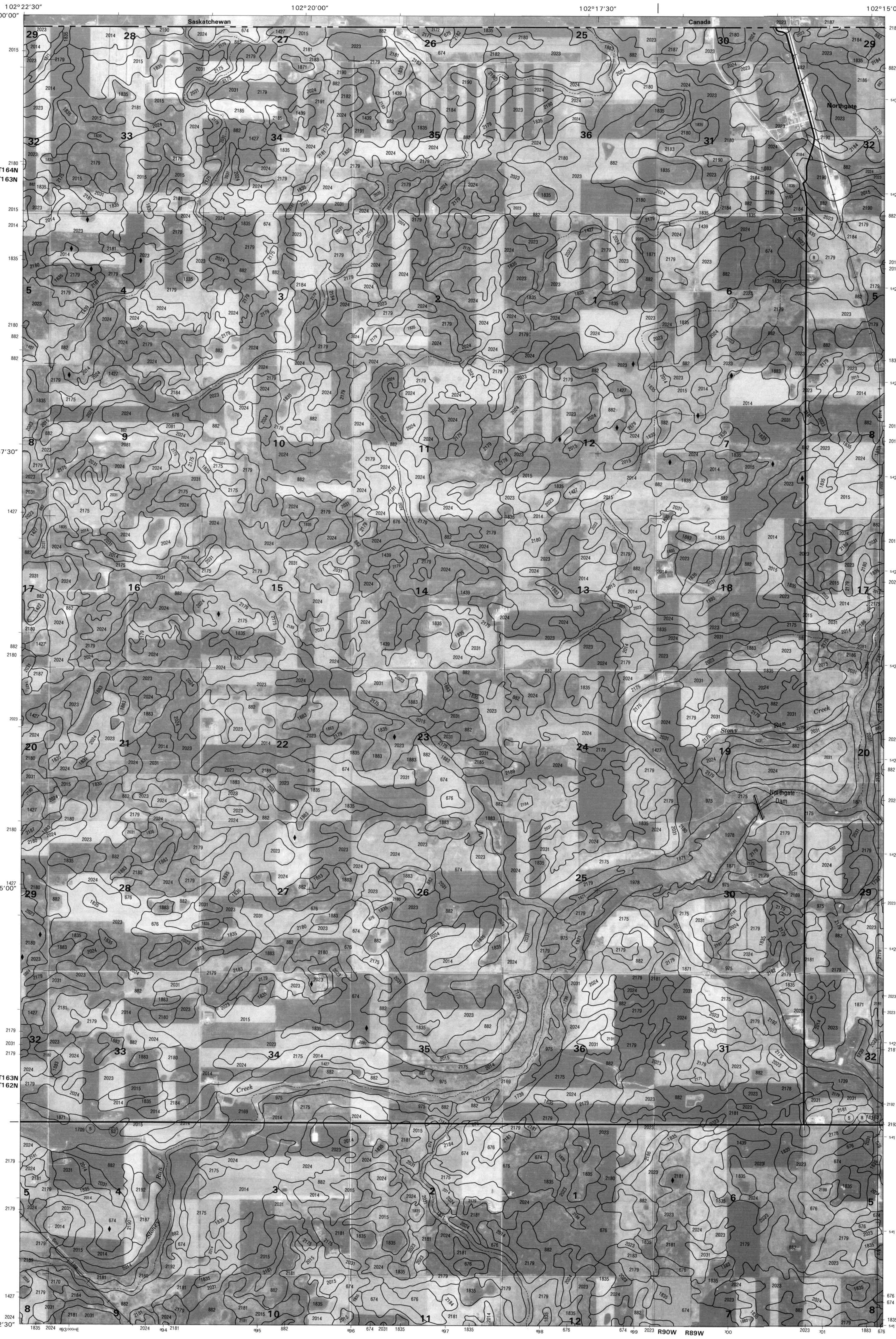
FLAXTON, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 5 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
NORTHGATE QUADRANGLE
SHEET NUMBER 6 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1
2
3
4 FLAXTON
5 BOWBELLS NW
6 WOBURN
7 COTEAU
8 BOWBELLS

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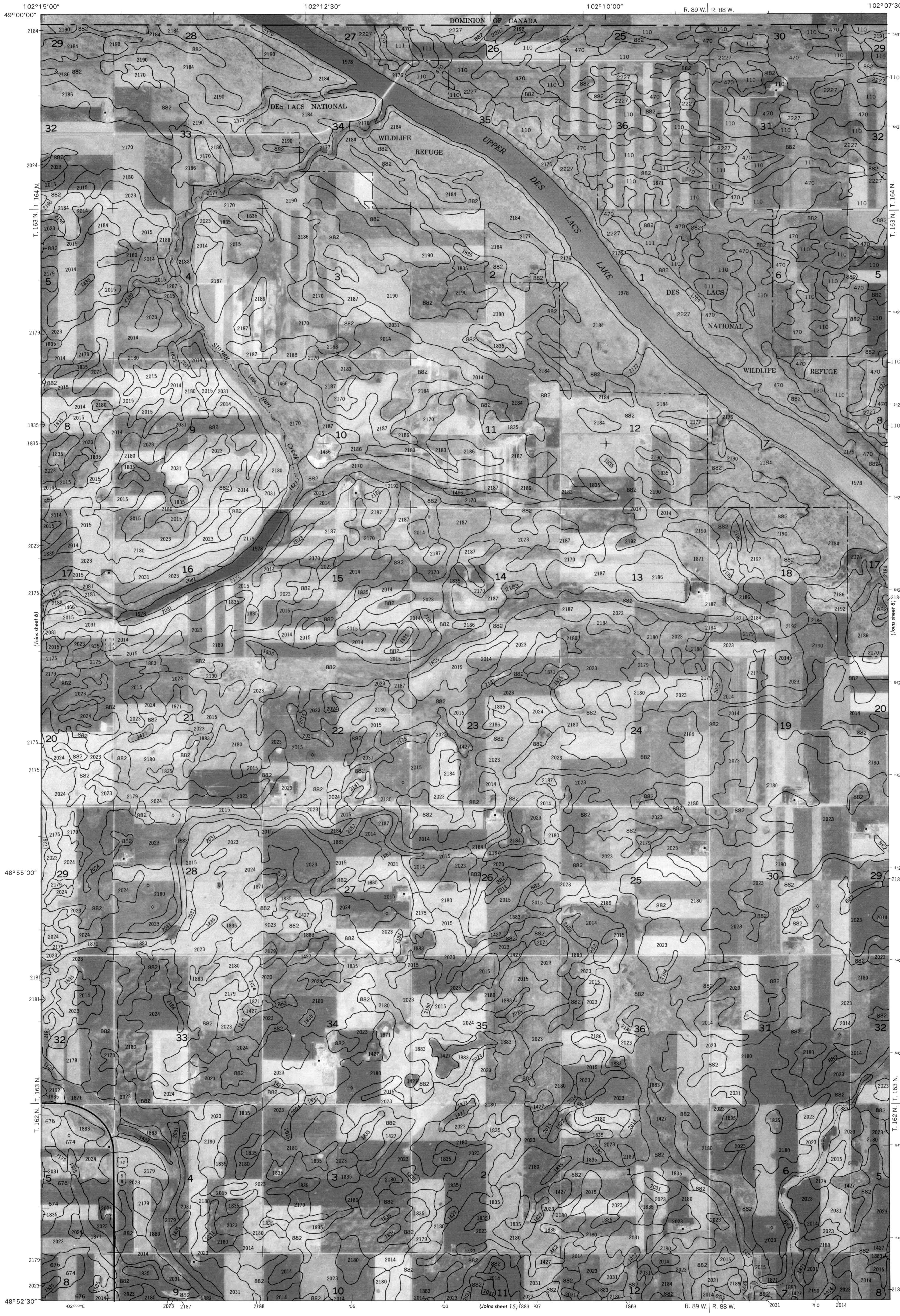
NORTHGATE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 6 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
BOWBELLS NW QUADRANGLE
SHEET NUMBER 7 OF 29



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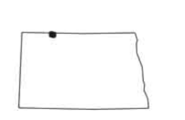
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid
1000-meter ticks: Universal Transverse Mercator, zone 13.
Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH



QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS 1 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000

MILES 1 0 1

1	2	3
4		5
6	7	8

1
2
3
4 NORTHGATE
5 BOWBELLS NE
6 COTEAU
7 BOWBELLS
8 BOWBELLS SE

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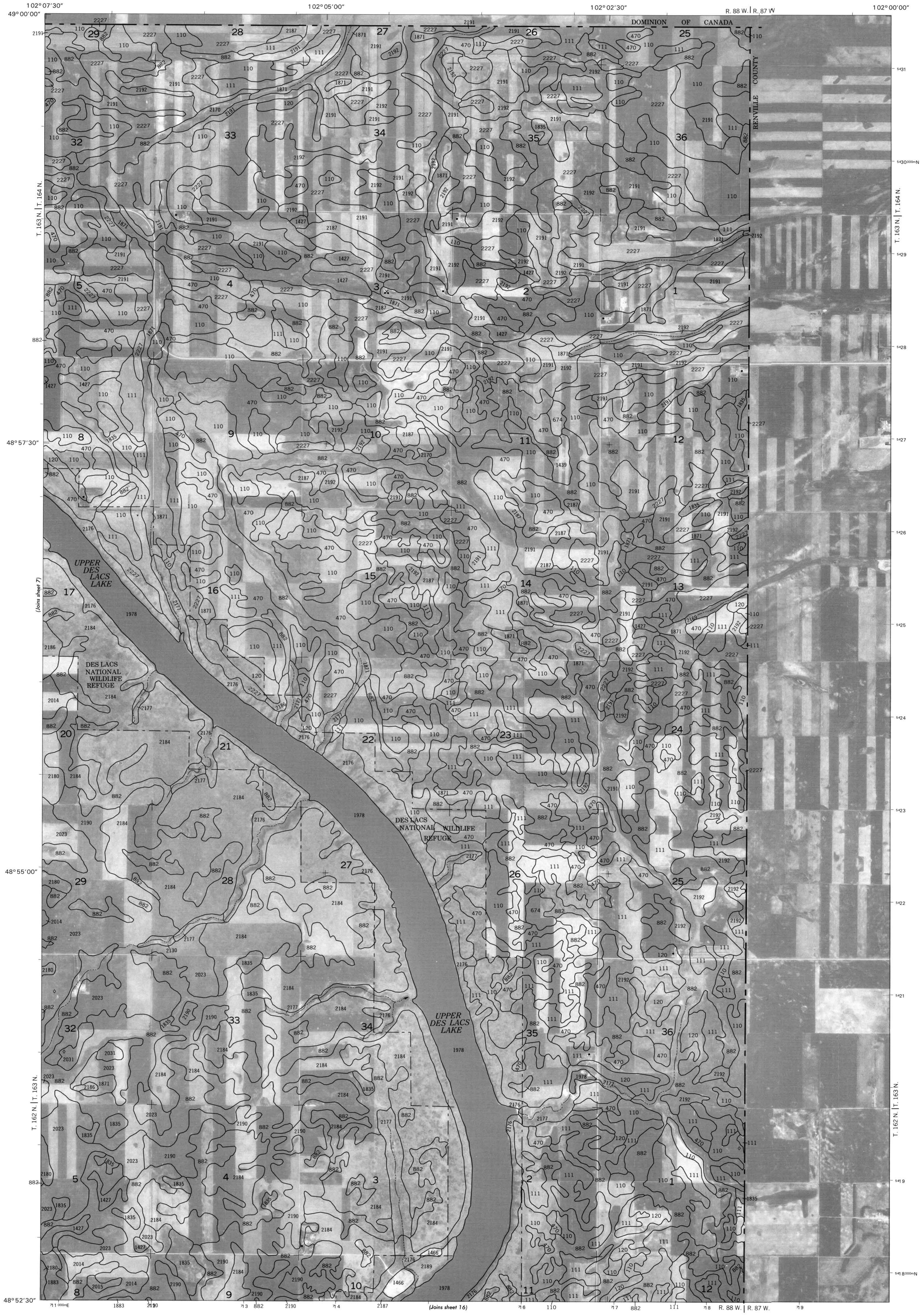
BOWBELLS NW, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 7 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

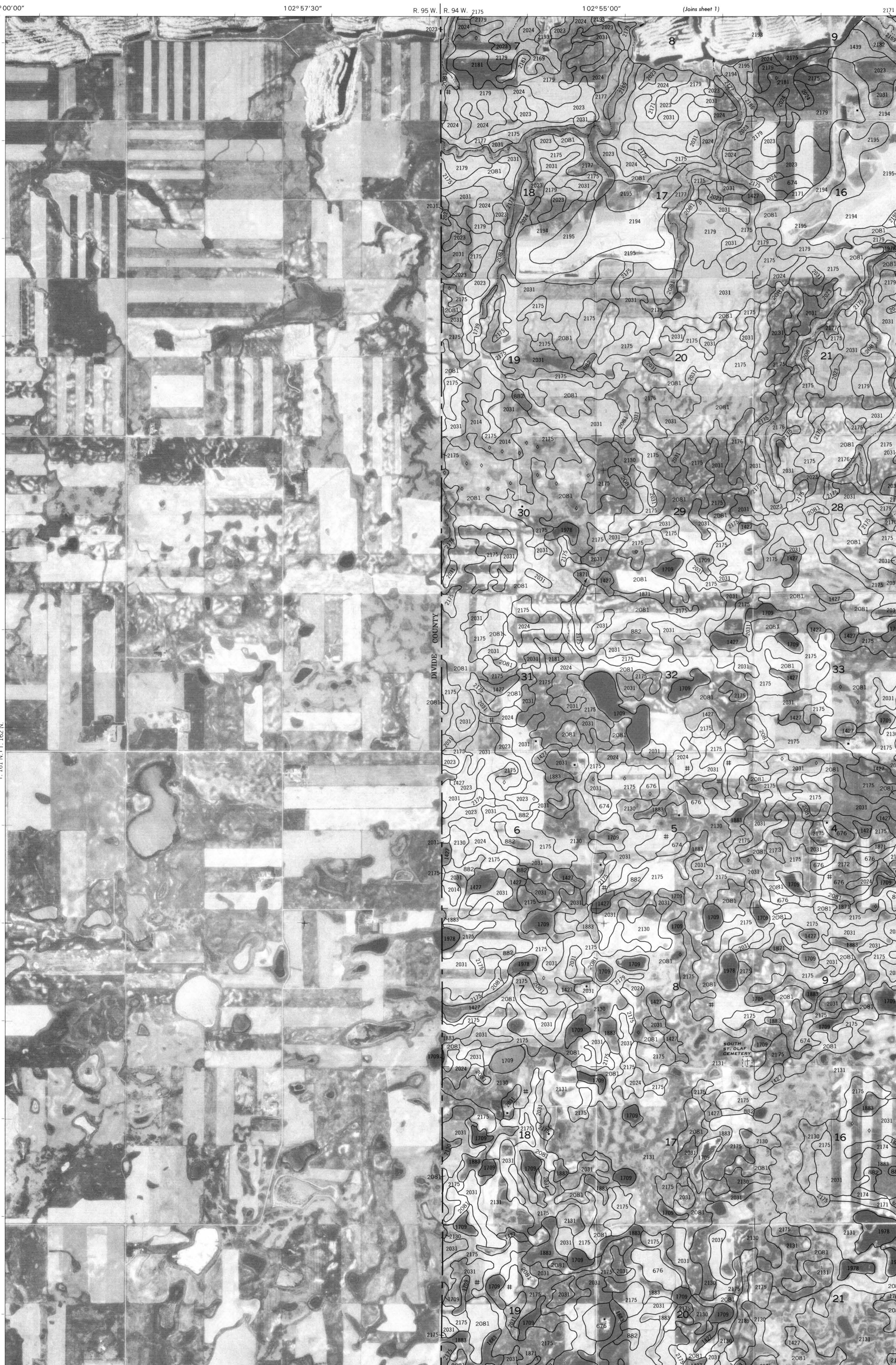
KILOMETERS

FEET

MILES

INDEX TO ADJOINING 7.5 MAPS
4 BOWBELLS NW
5 MOUSE RIVER PARK NW
6 BOWBELLS
7 BOWBELLS SE
8 MOUSE RIVER PARK SW

BOWBELLS NE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 8 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

1 0 1
KILOMETERS

1000 0 1000 2000 3000 4000 5000 6000 7000
FEET

1 0 1
MILES

1	2	3
4		5
6	7	8

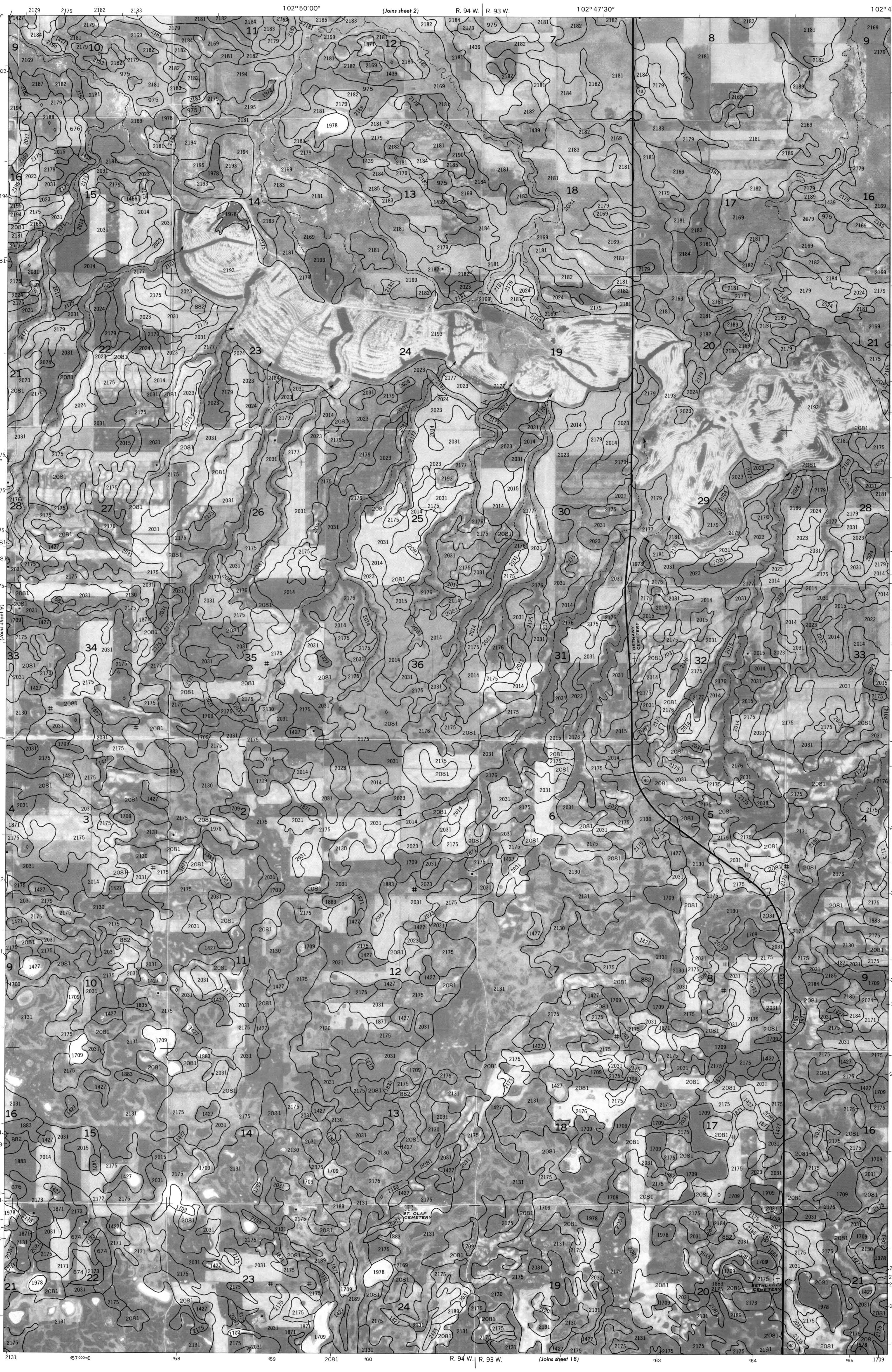
1 NOONAN
2 ATACOL
3 COLUMBUS
4 NOONAN SE
5 COLUMBUS SE
6 HAMLET
7 BUSH LAKE
8 GRAND VIEW

INDEX TO ADJOINING 7.5 MAPS

COLUMBUS SW, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 9 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
COLUMBUS SE QUADRANGLE
SHEET NUMBER 10 OF 29



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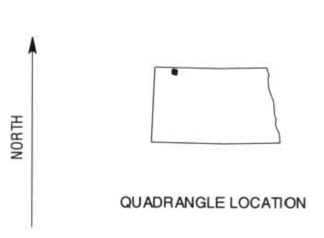
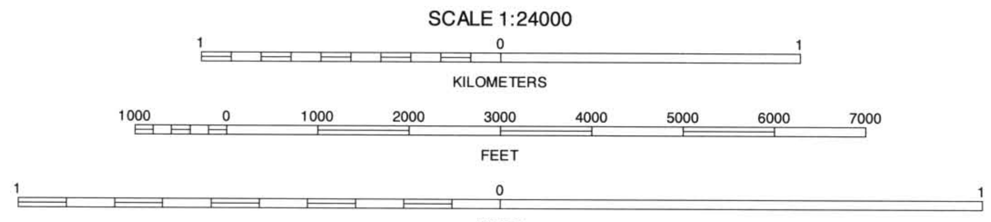
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.





1	2	3
4		5
6	7	8

1 ATACOL
2 COLUMBUS
3 STAMPEDE
4 COLUMBUS SW
5 BEAVER LAKE
6 BUSH LAKE
7 GRAND VIEW
8 GRUBB LAKE

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COLUMBUS SE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 10 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

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North American Datum of 1927 (NAD27), Clarke 1866 Spheroid
1000-meter ticks: Universal Transverse Mercator, zone 13.
Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

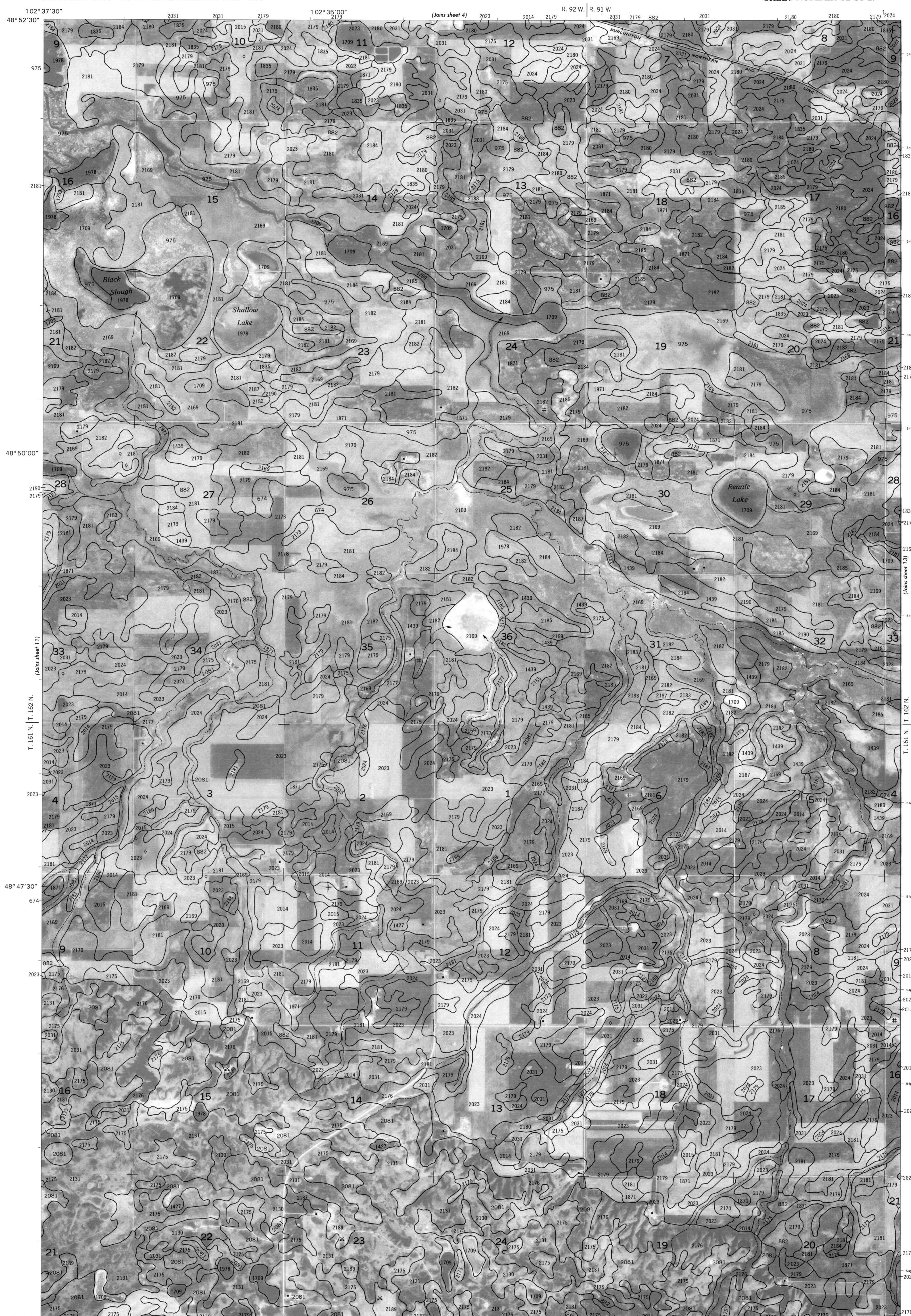
1	2	3
4		5
6	7	8

1 COLUMBUS
2 STAMPEDE
3 PORTAL
4 COLUMBUS SE
5 RENNIE LAKE
6 GRAND VIEW
7 GRUBB LAKE
8 HELDE LAKE

INDEX TO ADJOINING 7.5 MAPS

BEAVER LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 11 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 STAMPEDE
2 PORTAL
3 FLAXTON
4 BEAVER LAKE
5 WOBURN
6 GRUBB LAKE
7 HELDE LAKE
8 THOMPSON LAKE

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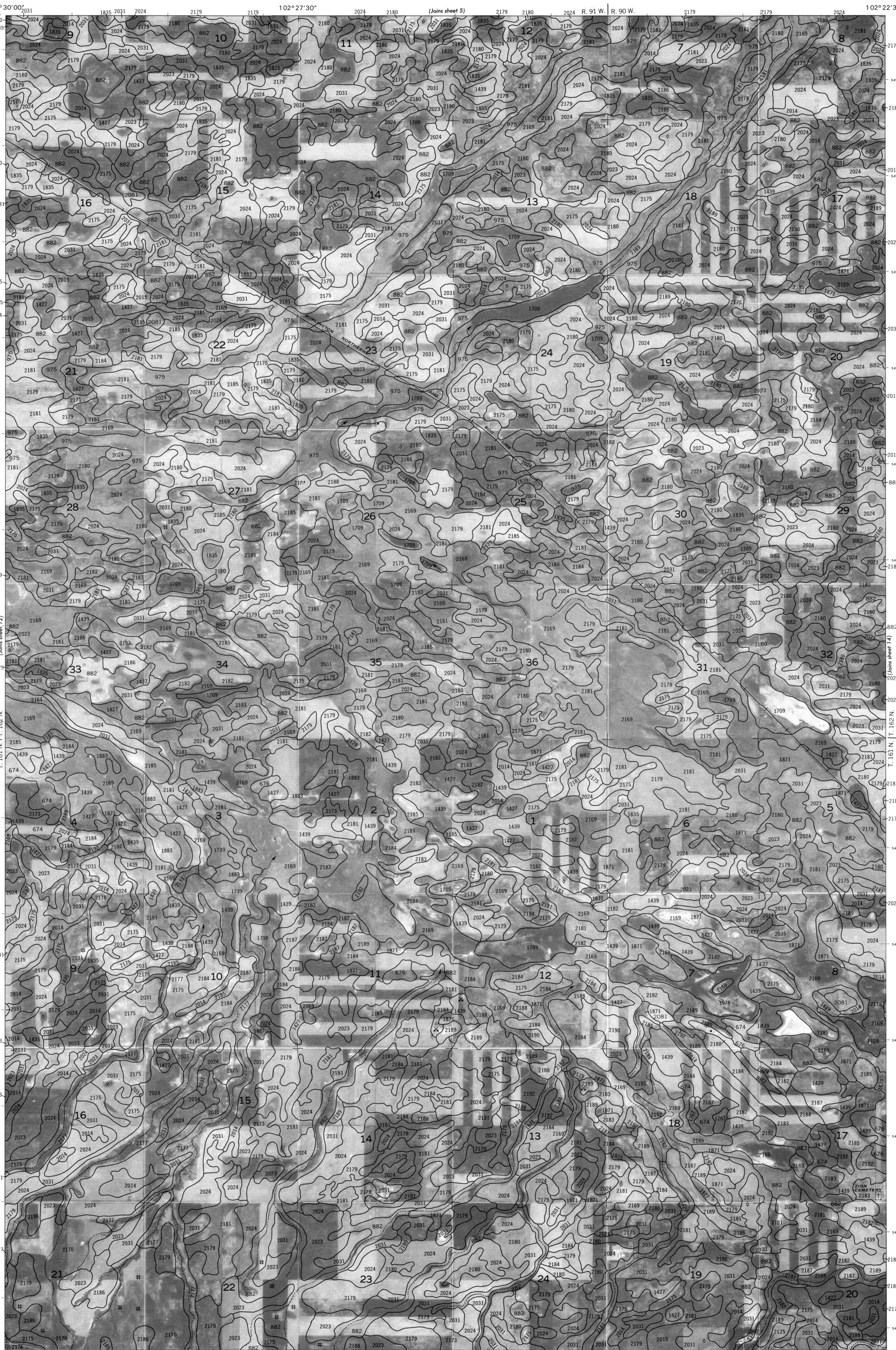
RENNIE LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 12 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
WOBURN QUADRANGLE
SHEET NUMBER 13 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

1 0 1 KILOMETERS

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 MILES

1	2	3
4		5
6	7	8

1 PORTAL
2 FLAXTON
3 NORTHGATE
4 RENNIE LAKE
5 COTEAU
6 HELDE LAKE
7 THOMPSON LAKE
8 VANVILLE NE

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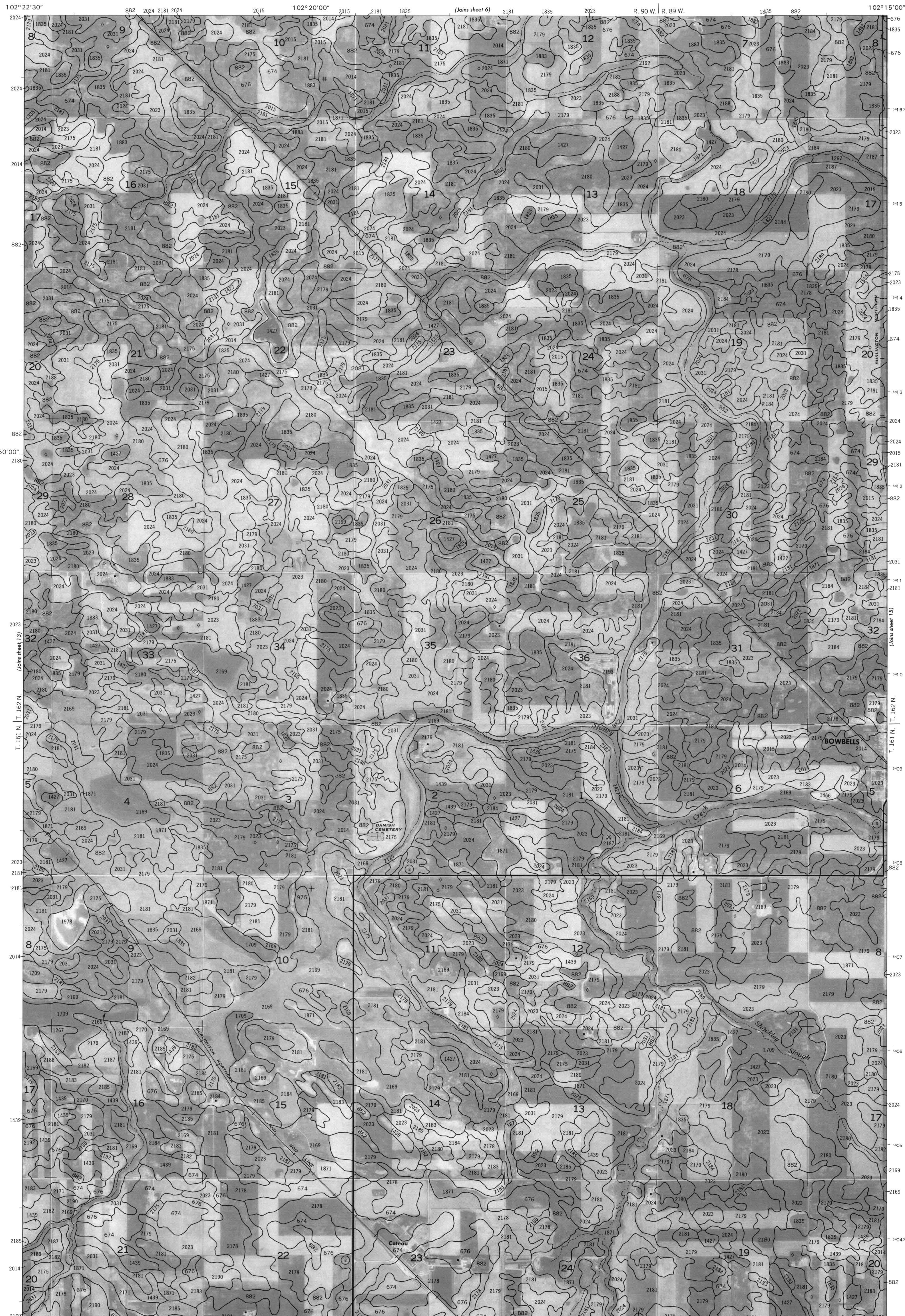
WOBURN, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 13 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
COTEAU QUADRANGLE
SHEET NUMBER 14 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS 1 0 1

FEET 1000 0 1000 2000 3000 4000 5000 6000 7000

MILES 1 0 1

1	2	3
4		5
6	7	8

1 FLAXTON
2 NORTHGATE
3 BOWBELLS NW
4 WOBURN
5 BOWBELLS
6 THOMPSON LAKE
7 VANVILLE NE
8 NIOBE

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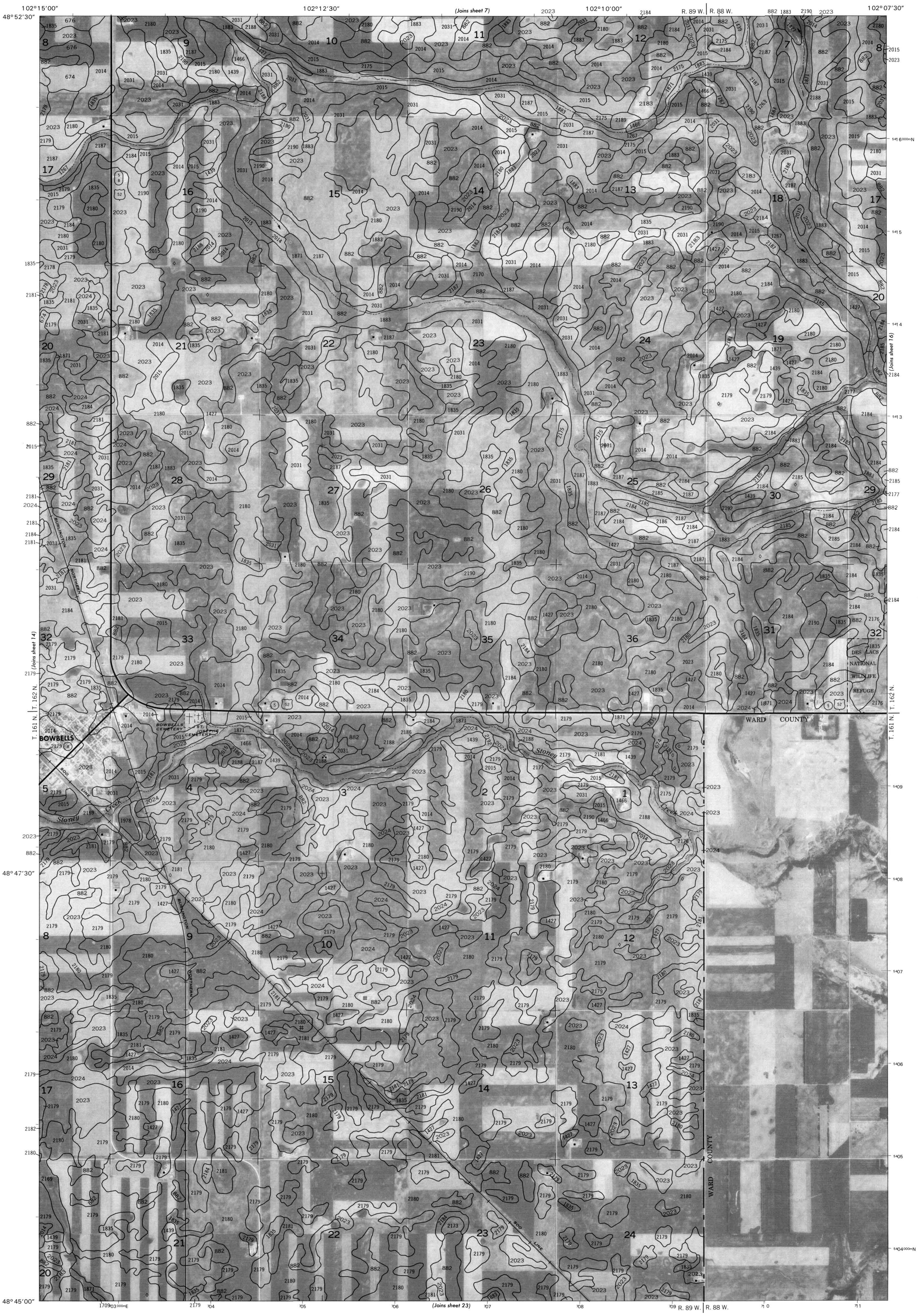
COTEAU, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 14 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
BOWBELLS QUADRANGLE
SHEET NUMBER 15 OF 29



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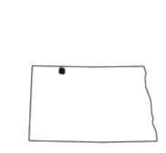
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH



QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 NORTHGATE
2 BOWBELLS NW
3 BOWBELLS NE
4 COTEAU
5 BOWBELLS SE
6 VANVILLE NE
7 NIOBE
8 KENMARE

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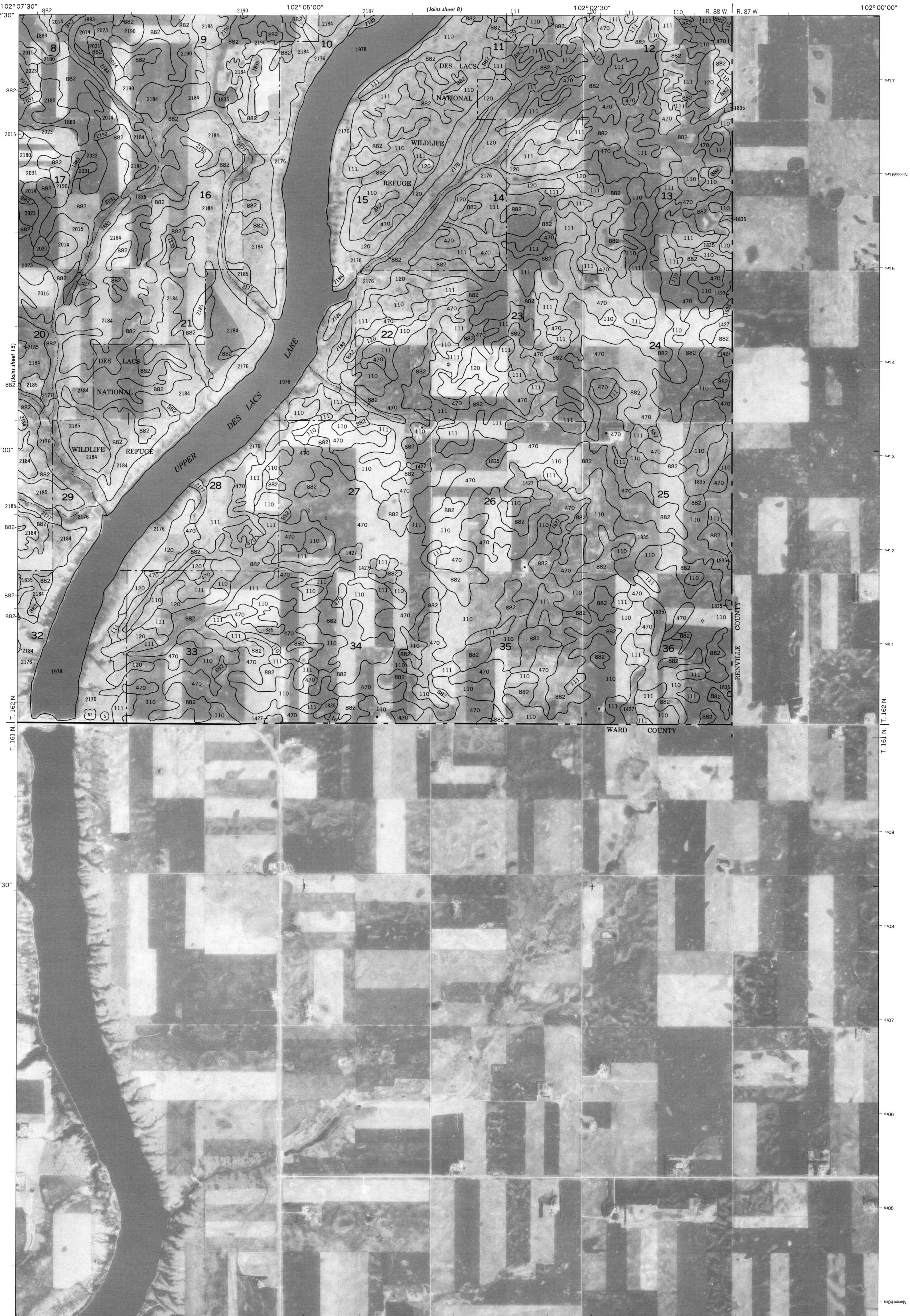
BOWBELLS, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 15 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
BOWBELLS SE QUADRANGLE
SHEET NUMBER 16 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 BOWBELLS NW
2 BOWBELLS NE
3 MOUSE RIVER PARK NW
4 BOWBELLS
5 MOUSE RIVER PARK SW
6 NIOBE
7 KENMARE
8 NORMA

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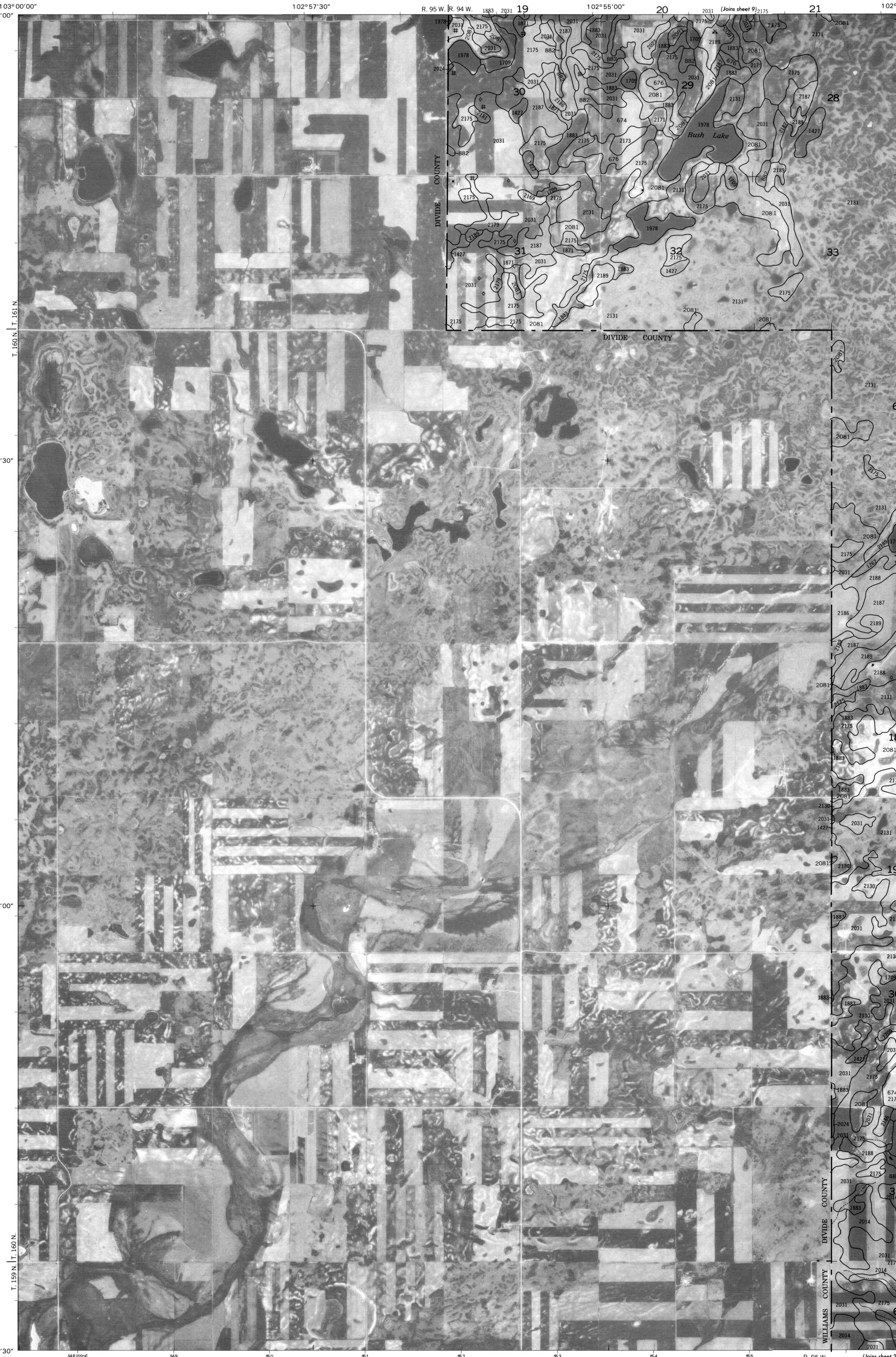
BOWBELLS SE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 16 OF 29



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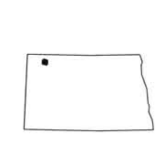
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH



QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 NOONAN SE
2 COLUMBUS SW
3 COLUMBUS SE
4 HAMLET
5 GRAND VIEW
6 BIG MEADOW
7 MCGREGOR
8 BATTLEVIEW

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BUSH LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 17 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid
1000-meter ticks: Universal Transverse Mercator, zone 13.
Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 COLUMBUS SW
2 COLUMBUS SE
3 BEAVER LAKE
4 BUSH LAKE
5 GRUBB LAKE
6 MCGREGOR
7 BATTLEVIEW
8 POWERS LAKE

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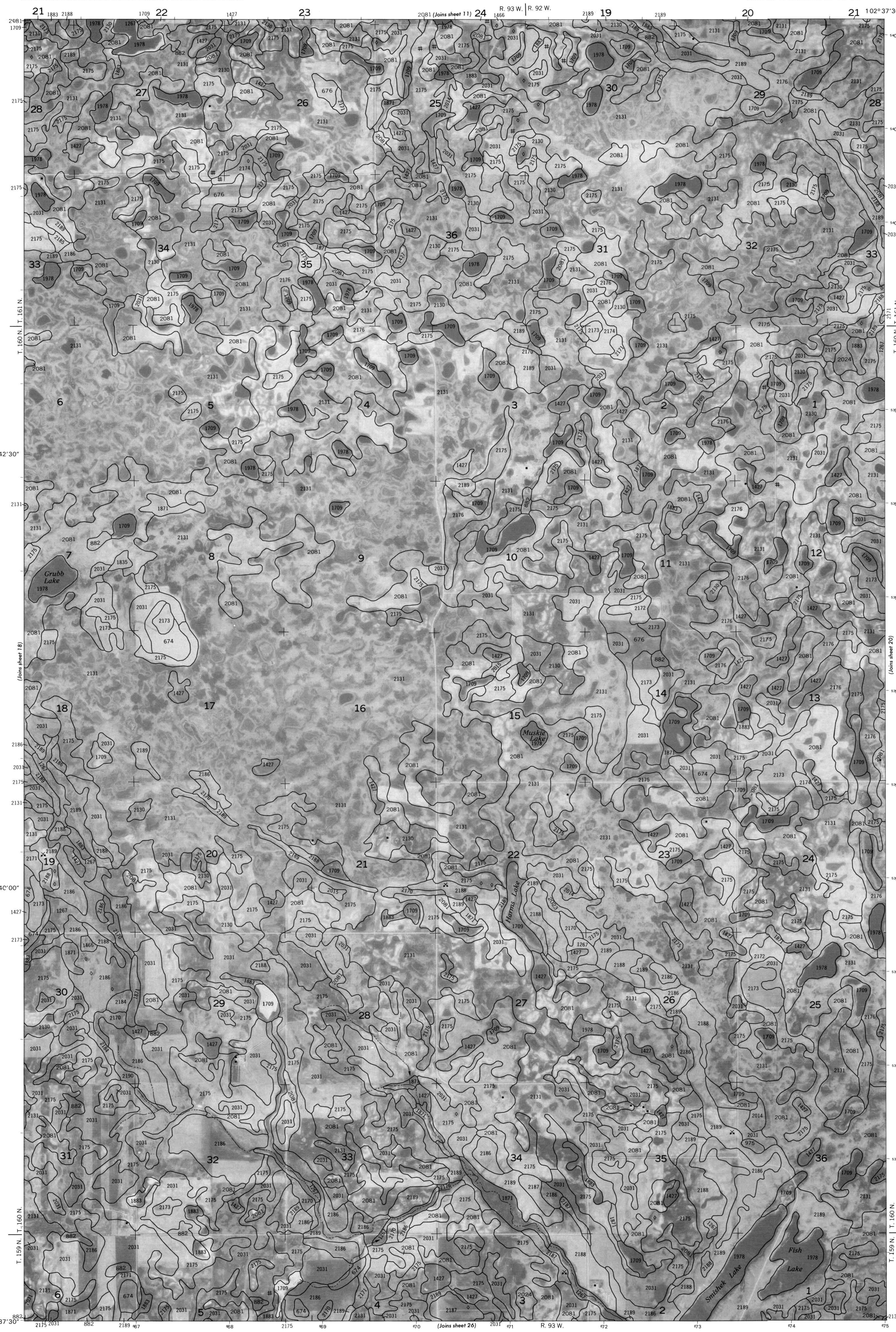
GRAND VIEW, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 18 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
GRUBB LAKE QUADRANGLE
SHEET NUMBER 19 OF 29



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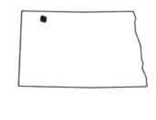
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH



QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

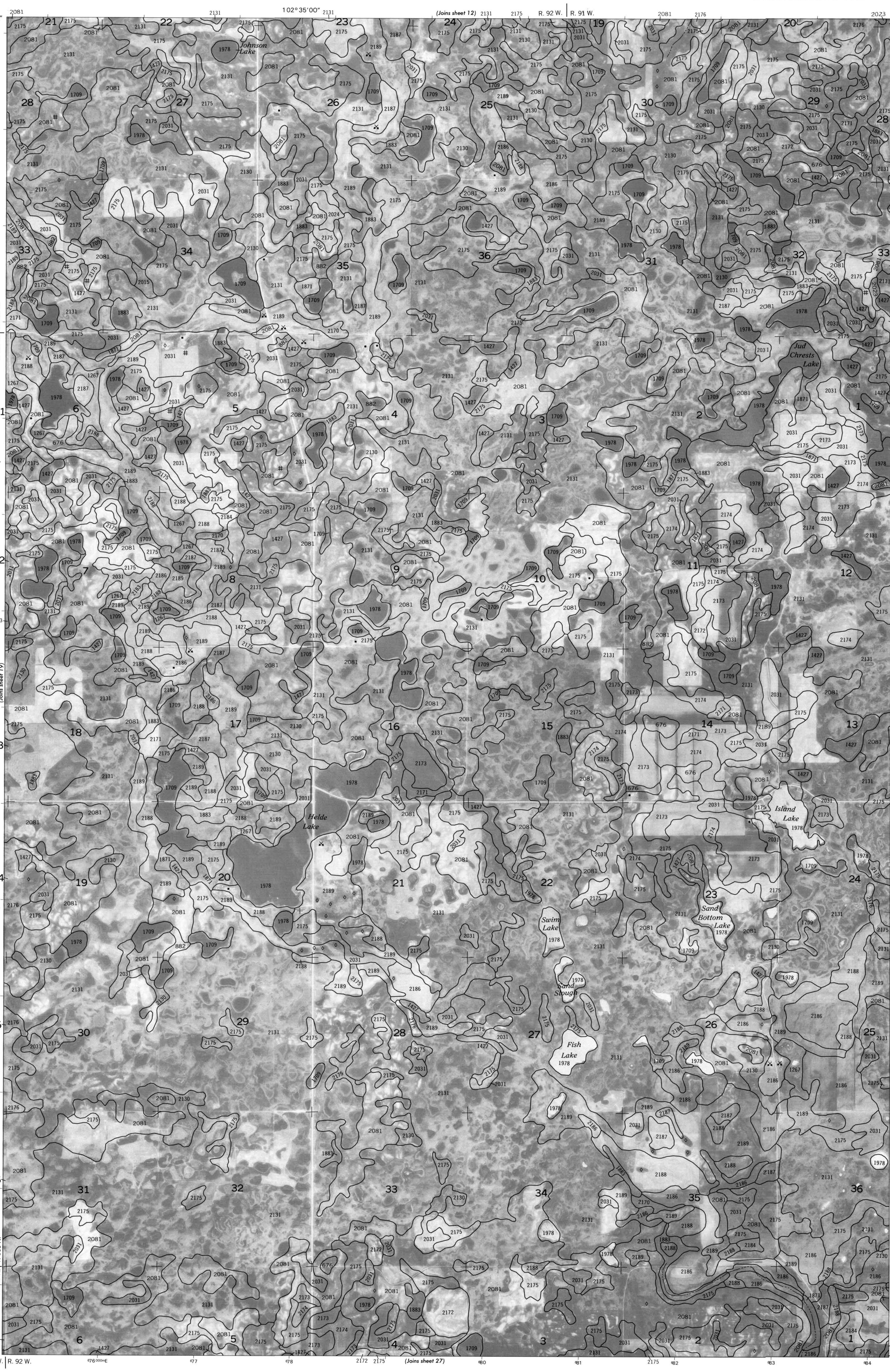
BURKE COUNTY, NORTH DAKOTA NO. 19

INDEX TO ADJOINING 7.5 MAPS

1 COLUMBUS SE
2 BEAVER LAKE
3 RENNIE LAKE
4 GRAND VIEW
5 HELDE LAKE
6 BATTLEVIEW
7 POWERS LAKE
8 LUNDS VALLEY

GRUBB LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 19 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE



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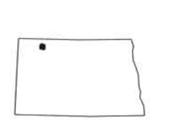
North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH



QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

1000 0 1000 2000 3000 4000 5000 6000 7000

FEET

MILES

1	2	3
4		5
6	7	8

1 BEAVER LAKE
2 RENNIE LAKE
3 WOBURN
4 GRUBB LAKE
5 THOMPSON LAKE
6 POWERS LAKE
7 LUNDS VALLEY
8 LOSTWOOD LAKES

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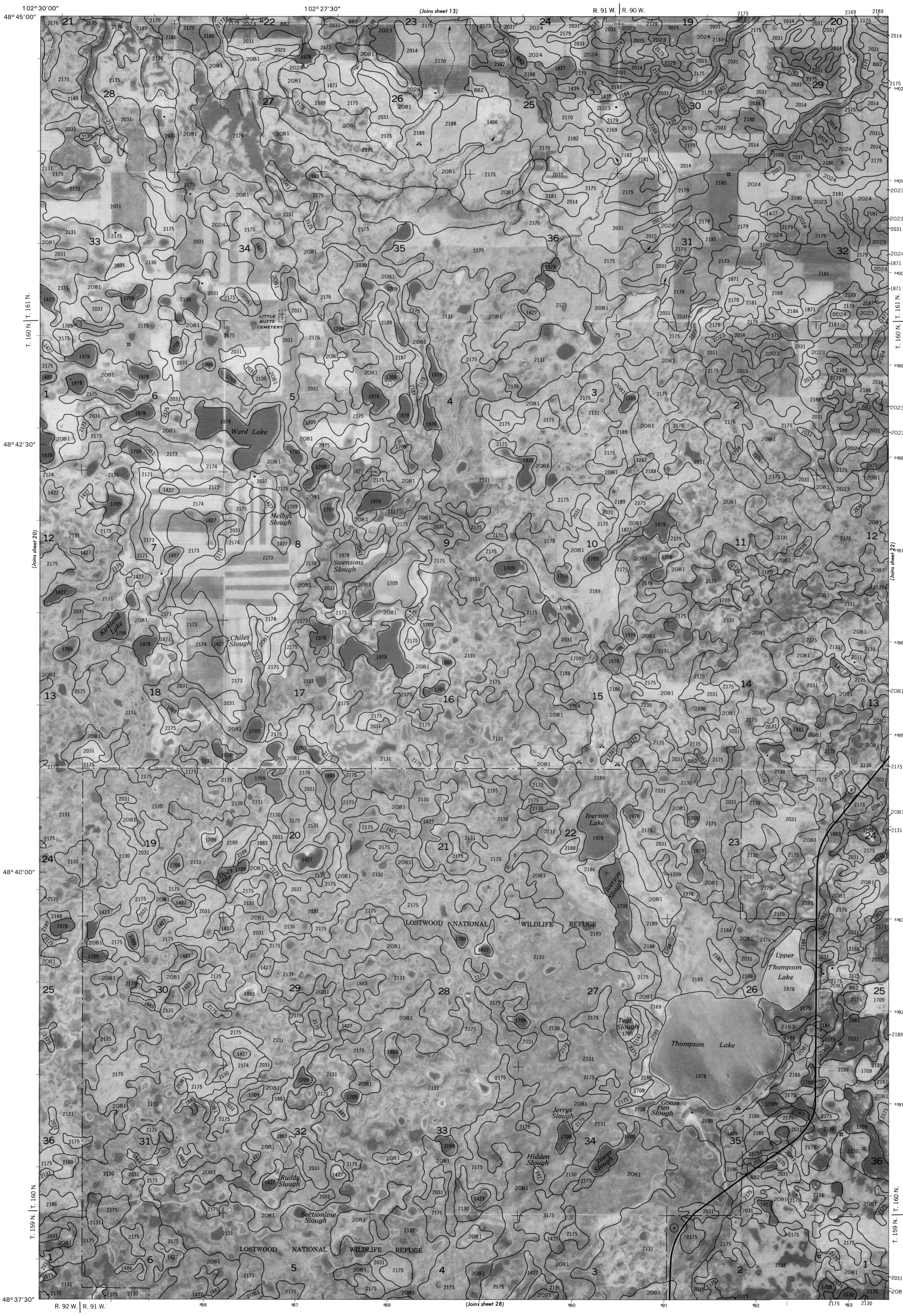
HELDE LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 20 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid
1000-meter ticks: Universal Transverse Mercator, zone 13.
Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

BURKE COUNTY, NORTH DAKOTA NO. 21

1	2	3
4		5
6	7	8

1 RENNIE LAKE
2 WOBURN
3 COTEAU
4 HELDE LAKE
5 VANVILLE NE
6 LUNDS VALLEY
7 LOSTWOOD LAKES
8 WESTBY LAKE

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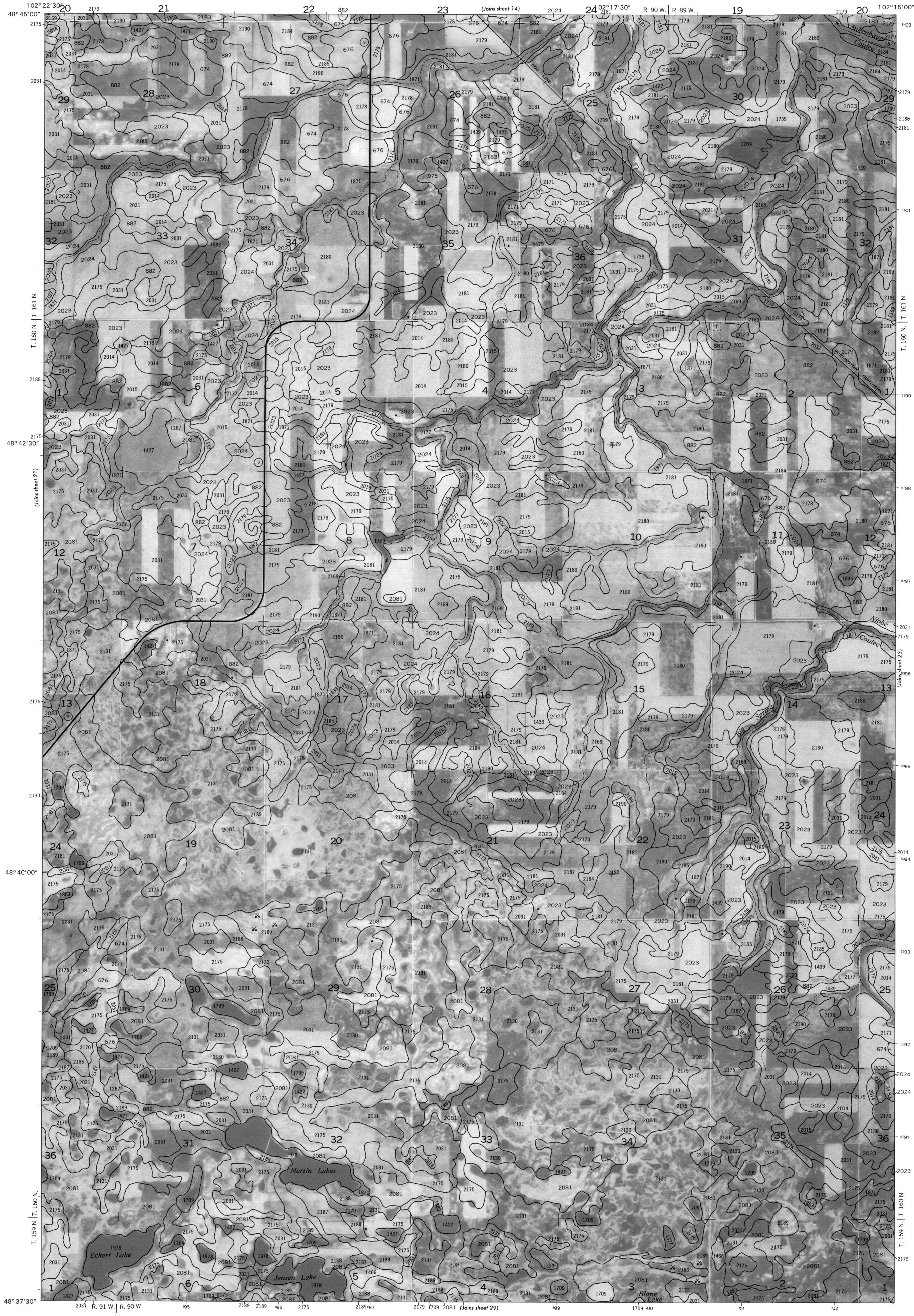
THOMPSON LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 21 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
VANVILLE NE QUADRANGLE
SHEET NUMBER 22 OF 29



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 WOBURN
2 COTEAU
3 BOWBELLS
4 THOMPSON LAKE
5 NIOBE
6 LOSTWOOD LAKES
7 WESTBY LAKE
8 MOSQUITO BUTTE

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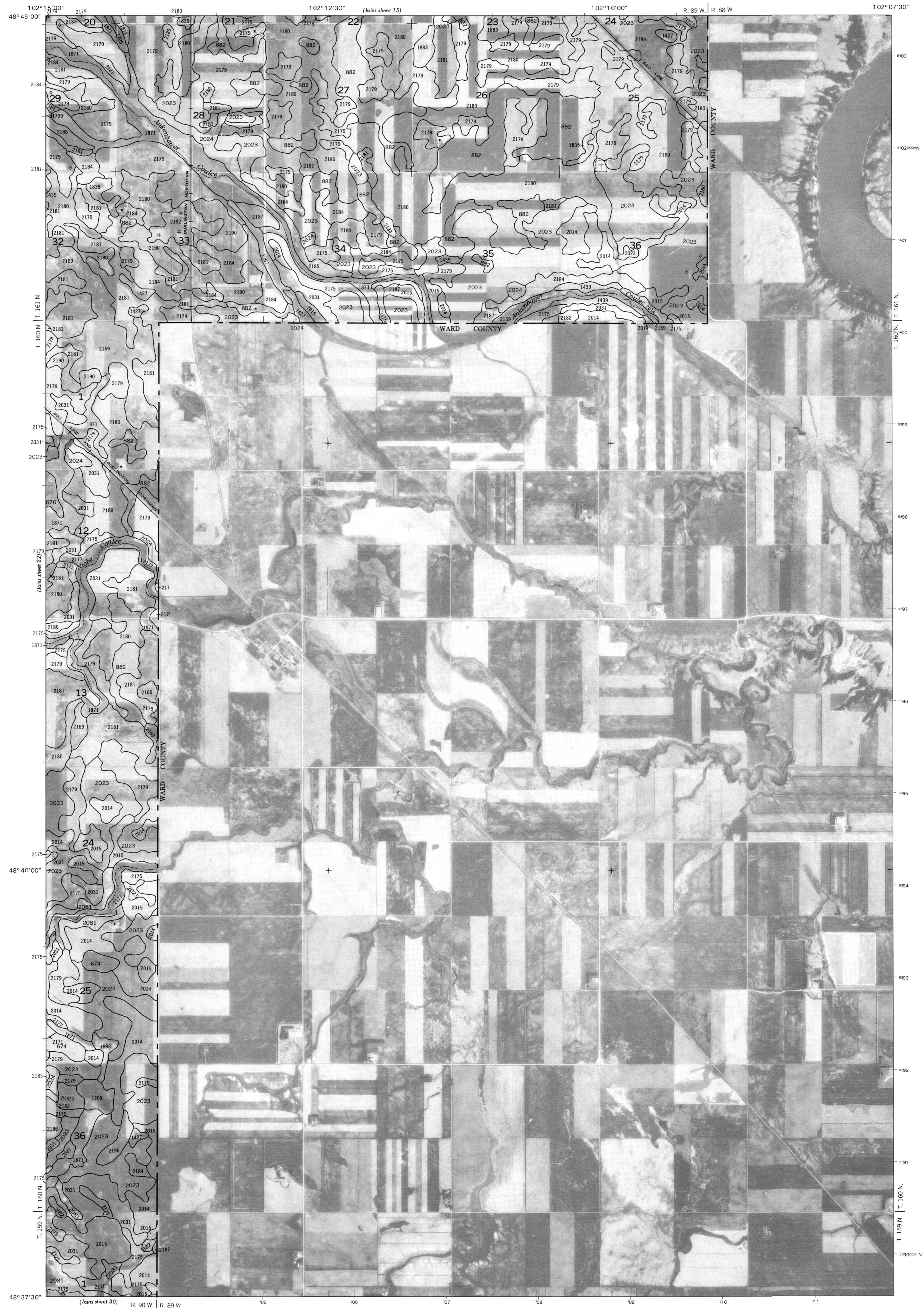
VANVILLE NE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 22 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

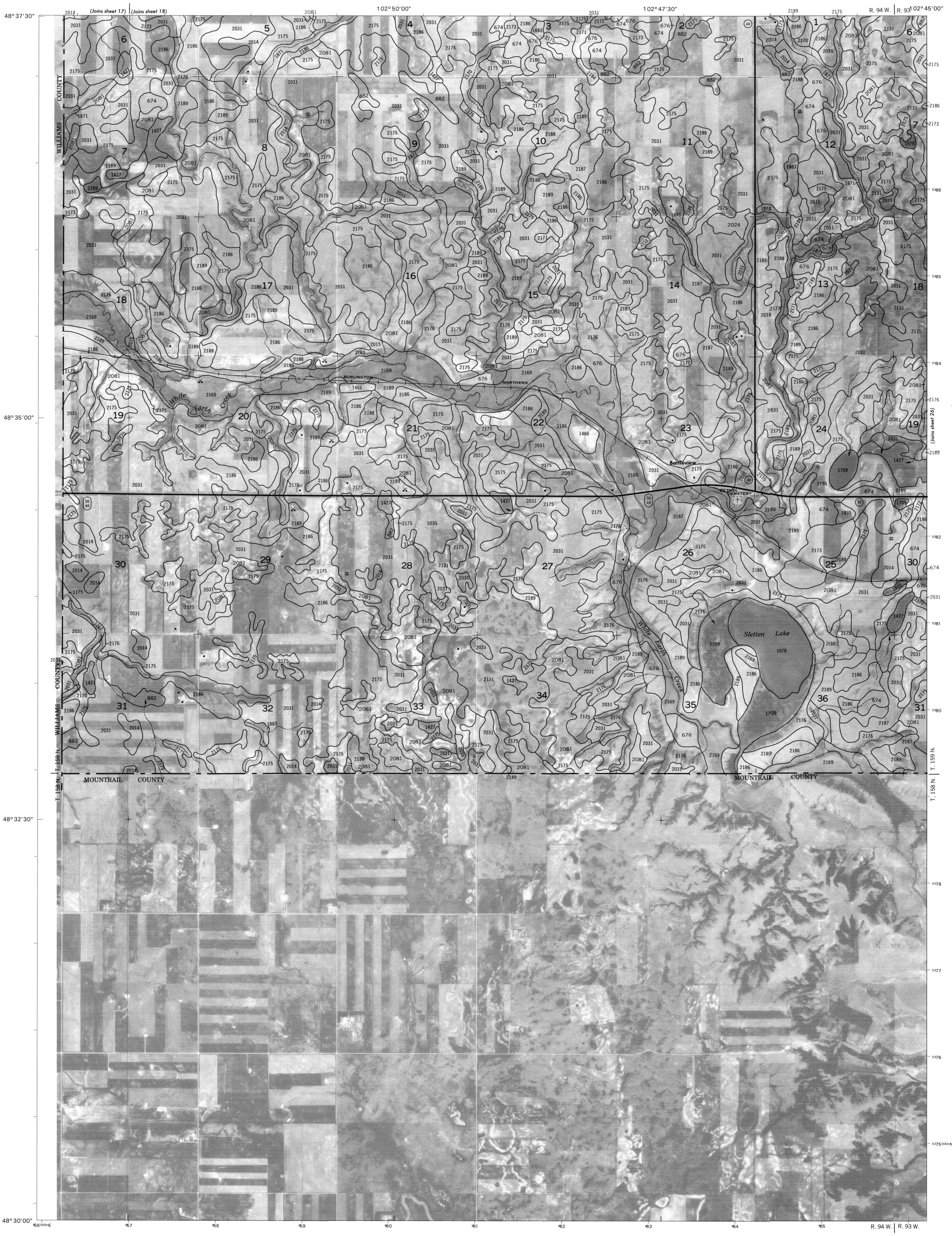
1 COTEAU
2 BOWBELLS
3 BOWBELLS SE
4 VANVILLE NE
5 KENMARE
6 WESTBY LAKE
7 MOSQUITO BUTTE
8 COULEE

INDEX TO ADJOINING 7.5 MAPS

NIOBE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 23 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
BATTLEVIEW QUADRANGLE
SHEET NUMBER 24 OF 29



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3	1 BUSH LAKE
4		5	2 GRAND VIEW
6	7	8	3 GRUBB LAKE

4 MCGREGOR
5 POWERS LAKE
6 TIOGA
7 WHITE EARTH
8 ROSS NW

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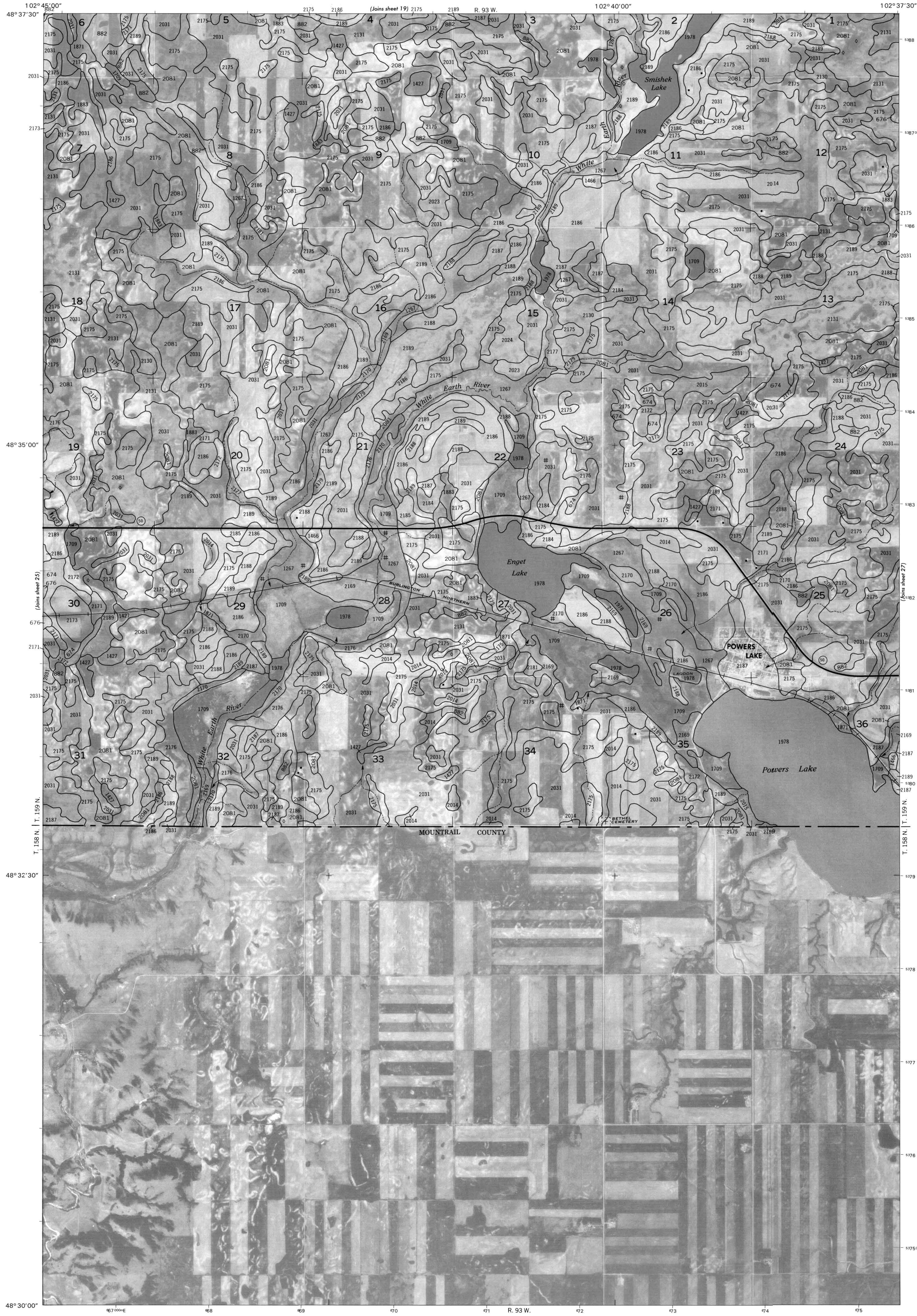
BATTLEVIEW, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 24 OF 29



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

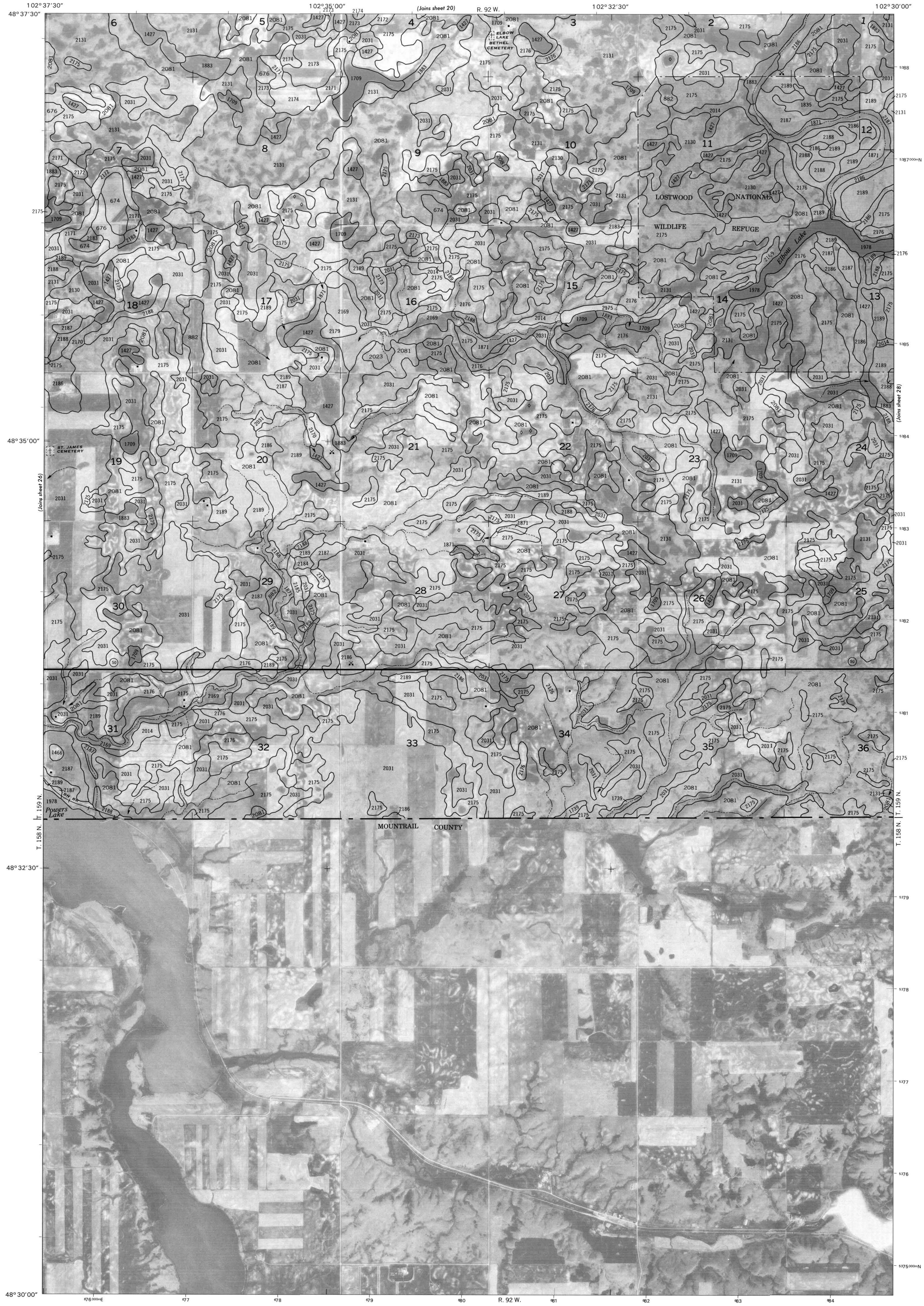
MILES

1	2	3
4		5
6	7	8

1 GRAND VIEW
2 GRUBB LAKE
3 HELDE LAKE
4 BATTLEVIEW
5 LUNDS VALLEY
6 WHITE EARTH
7 ROSS NW
8 COTTONWOOD LAKE

INDEX TO ADJOINING 7.5 MAPS

POWERS LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 25 OF 29



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 GRUBB LAKE
2 HELDE LAKE
3 THOMPSON LAKE
4 POWERS LAKE
5 LOSTWOOD LAKES
6 ROSS NW
7 COTTONWOOD LAKE
8 LOSTWOOD

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LUNDS VALLEY, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 26 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
LOSTWOOD LAKES QUADRANGLE
SHEET NUMBER 27 OF 29

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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 HELDE LAKE
2 THOMPSON LAKE
3 VANVILLE NE
4 LUNDS VALLEY
5 WESTBY LAKE
6 COTTONWOOD LAKE
7 LOSTWOOD
8 CLEARWATER LAKE

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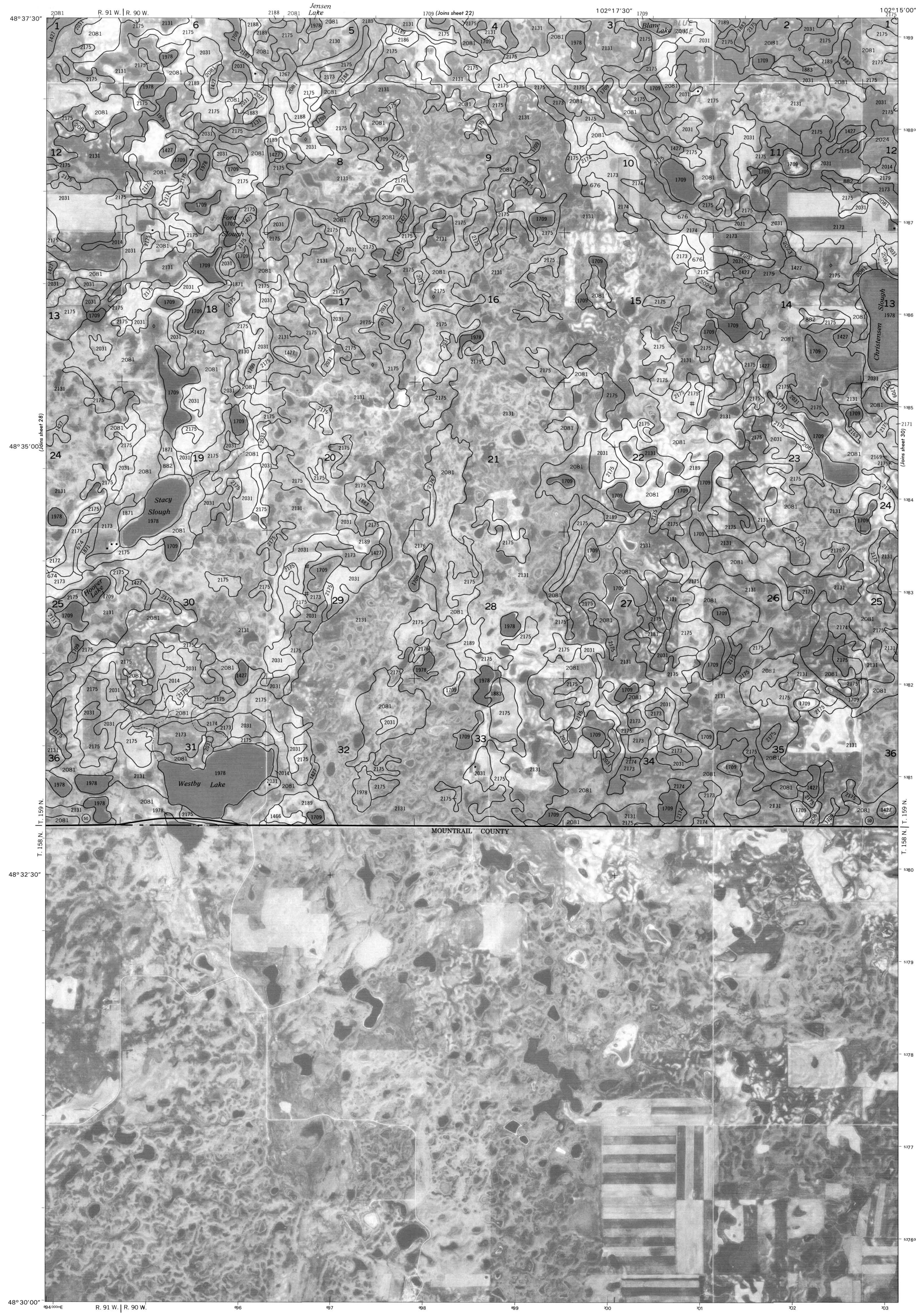
LOSTWOOD LAKES, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 27 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
WESTBY LAKE QUADRANGLE
SHEET NUMBER 28 OF 29



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NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS

FEET

MILES

1	2	3
4		5
6	7	8

1 THOMPSON LAKE
2 VANVILLE NE
3 NIOBE
4 LOSTWOOD LAKES
5 MOSQUITO BUTTE
6 LOSTWOOD
7 CLEARWATER LAKE
8 PALERMO NW

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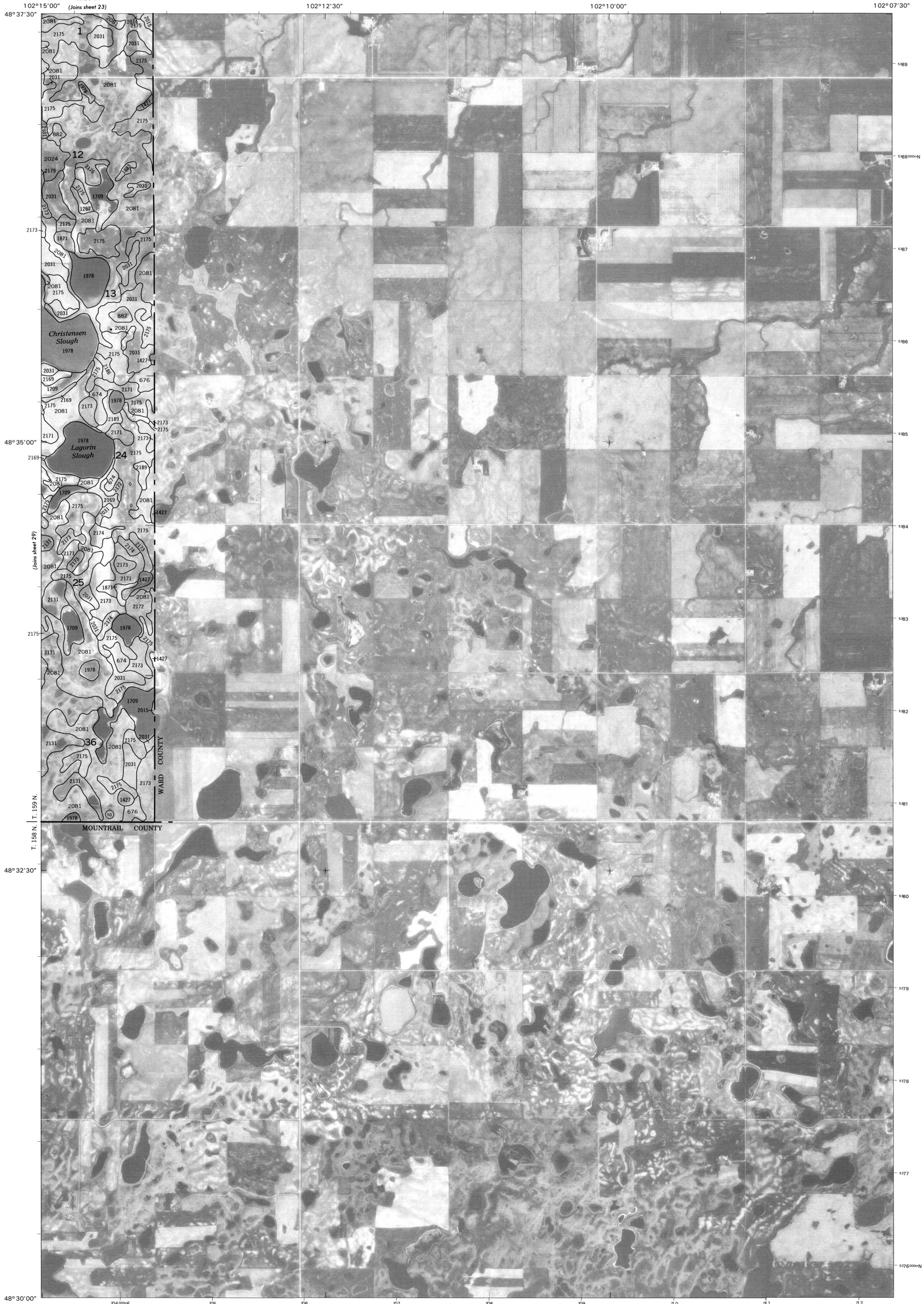
WESTBY LAKE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 28 OF 29

UNITED STATES
DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

BURKE COUNTY, NORTH DAKOTA
MOSQUITO BUTTE QUADRANGLE
SHEET NUMBER 29 OF 29



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North American Datum of 1927 (NAD27). Clarke 1866 Spheroid 1000-meter ticks: Universal Transverse Mercator, zone 13. Coordinate grid ticks and land division data, if shown, are approximately positioned. Digital data are available for this quadrangle.

NORTH

QUADRANGLE LOCATION

SCALE 1:24000

KILOMETERS: 1 0 1

FEET: 1000 0 1000 2000 3000 4000 5000 6000 7000

MILES: 1 0 1

1	2	3
4		5
6	7	8

1 VANVILLE NE
2 NIOBE
3 KENMARE
4 WESTBY LAKE
5 COULEE
6 CLEARWATER LAKE
7 PALERMO NW
8 PALERMO NE

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MOSQUITO BUTTE, NORTH DAKOTA
7.5 MINUTE SERIES
SHEET NUMBER 29 OF 29